Quantum™ MEDICAL IMAGING

ODYSSEY, Q-VISION HF Series™ X-ray Generators

Service Manual

Manual Part No. DC30-011 Revision W

CE
0473

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Revision History

REVISION	DATE	TYPE OF MODIFICATION
E	1/12/02	Incorporated ECO 0647, 0651, 0687
F	2/25/02	Incorporated ECO 0714, 0718, 0738, 0742
G	5/15/02	Incorporated ECO 0642, 0748, 0753, 0770, 0787, 0803, 0809, 0821, 0827, 0829, 0830, 0847, 0859, 0881, 0888
H	9/26/02	Incorporated ECO 0787
J	11/11/02	Incorporated ECO 0936, 1003, 1009, 1010, 1017, 1028, 1030
K	3/31/03	Incorporated ECO 1093, 1102, 1103, 1107, 1115, 1124, 1146
L	7/11/03	Incorporated ECO 1255, 1256
M	7/29/03	Incorporated ECO 1269, 1270, 1272
N	12/19/03	Incorporated ECO 1144, 1216, 1347, 1359, 1362, 1380, 1383, 1400
P	9/10/04	Incorporated ECO 1346, 1438, 1485, 1518
Q	4/22/05	Incorporated ECO 1565, 1570, 1600, 1606, 1607
R	12/20/05	Incorporated ECO 1660, 1663, 1679
S	5/22/07	Assigned new part number to Non-QMI HSS version manual; Incorporated ECO 1697, 1715, 1757, 1794, 1890
T	5/8/2008	Incorporate ECO 1895, 1920, 1932, 1977, 1985
U	11/21/2008	Incorporate ECO 2045, 2050, 2068, 2093, 2105
V	9/1/2009	Incorporate ECO 1980, 2160, 2166, 2169
W	1/15/2010	Incorporate ECO 2220, 2228, 2276

Page Number	Rev	Page Number	Rev	Page Number	Rev
i thru xii	W	4-1 thru 4-20	W	B-1 thru B-56	W
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Chapter 1

SPECIFICATIONS

SYSTEM CONFIGURATIONS

The tables below show model numbers of components in each type of HF Series™ X-ray Generator system (hereinafter referred to as the "HF Series X-ray Generators").

Note: The X-Ray Control Models shown in the following tables are not used if the HF generator system is integrated with computed radiographic (CR) or digital radiographic (DR) workstation computer (e.g., Agfa NX, Canon CXDI, etc.).

Single-Phase Model Generators

SYSTEM TYPE	CATALOG NO.	SYSTEM MODEL	GENERATOR CABINET MODEL	X-RAY CONTROL MODEL*
ODYSSEY HF 32 kW	QG-3200	QG-32	QG-32G	QG-3200
ODYSSEY HF 32 kW		QG-32-5	QG-32G-5	QG-3200
ODYSSEY HF 40 kW	QG-4000	QG-40	QG-40G	QG-4000
ODYSSEY HF 40 kW		QG-40-5	QG-40G-5	QG-4000
Q-VISION HF 32 kW	QGV-32	QG-32	QG-32G	QGV-32
	QGV-32-5	QG-32-5	QG-32G-5	
Q-VISION HF 40 kW	QGV-40	QG-40	QG-40G	QGV-40
	QGV-40-5	QG-40-5	QG-40G-5	

Three-Phase Model Generators

SYSTEM TYPE	CATALOG NO.	SYSTEM MODEL	GENERATOR CABINET MODEL	X-RAY CONTROL MODEL
ODYSSEY HF 32 kW	QG-3200	QG-32-2	QG-32G-2	QG-3200
		QG-32-3	QG-32G-3	
ODYSSEY HF 40 kW	QG-4000	QG-40-2	QG-40G-2	QG-4000
		QG-40-3	QG-40G-3	
ODYSSEY HF 50 kW	QG-5000	QG-50-2	QG-50G-2	QG-5000
		QG-50	QG-50G	

Chapter 1 Specifications

Three-Phase Model Generators

SYSTEM TYPE	CATALOG NO.	SYSTEM MODEL	GENERATOR CABINET MODEL	X-RAY CONTROL MODEL
ODYSSEY HF 65 kW	QG-6500	QG-65	QG-65G	QG-6500
ODYSSEY HF 80 kW	QG-8000	QG-80	QG-80G	QG-8000
Q-VISION HF 32 kW	QGV-32-2	QG-32-2	QG-32G-2	QGV-32
	QGV-32-3	QG-32-3	QG-32G-3	
Q-VISION HF 40 kW	QGV-40-2	QG-40-2	QG-40G-2	QGV-40
	QGV-40-3	QG-40-3	QG-40G-3	
Q-VISION HF 50 kW	QGV-50-2	QG-50-2	QG-50G-2	QGV-50
	QGV-50	QG-50	QG-50G	
Q-VISION HF 65 kW	QGV-65	QG-65	QG-65G	QGV-65
Q-VISION HF 80 kW	QGV-80	QG-80	QG-80G	QGV-80

STORED ENERGY (SE) Model Generators

SYSTEM TYPE	CATALOG NO.	SYSTEM MODEL	GENERATOR CABINET MODEL	X-RAY CONTROL MODEL
ODYSSEY HF 32 kW	QG-3200-SE	QG-32-SE	QG-32G-SE	QG-3200
ODYSSEY HF 40 kW	QG-4000-SE	QG-40-SE	QG-40G-SE	QG-4000
ODYSSEY HF 50 kW	QG-5000-SE	QG-50-SE	QG-50G-SE	QG-5000
Q-VISION HF 32 kW	QGV-32-SE	QG-32-SE	QG-32G-SE	QGV-32-SE
Q-VISION HF 40 kW	QGV-40-SE	QG-40-SE	QG-40G-SE	QGV-40-SE
Q-VISION HF 50 kW	QGV-50-SE	QG-50-SE	QG-50G-SE	QGV-50-SE

PHYSICAL SPECIFICATIONS

The following are physical specifications of the HF Series X-ray Generators:

GENERATOR CABINET SPECIFICATIONS

Width:	24.0 inches (609.6 mm)
Depth:	20.0 inches (508.0 mm)
Height:	34.7 inches (881.4 mm)
Weights:	
Single-Phase (non-SE units):	298 lbs. (135.2 kg)
32, 40 and 50 kW Stored Energy (SE) units:	431 lbs. (195.5 kg)
50, 65, 80 kW Three-Phase units):	380 lbs. (712.4 kg) w/o internal HSS 388 lbs. (176.0 kg) w/internal HSS

OPERATOR CONTROL PANEL SPECIFICATIONS

Note: X-Ray Control Panels below are utilized with HF generator systems integrated with computed radiographic (CR) or digital radiographic (DR) workstation computers (e.g., Agfa NX, Canon CXDI, etc.).

The Q-VISION all-in-one operator control is not powered from the generator cabinet; it requires a separate 100-240 VAC, 3A power input.

ODYSSEY HF Control Panel:

Width:	17.9 inches (454.7 mm)
Depth:	12.25 inches (311.2 mm)
Height (without pedestal):	3.3 inches (83.8 mm)
Height (with pedestal):	36.5 inches (927.4 mm)
Weight (without pedestal):	5 lbs. (2.3 kg)
Weight (with pedestal):	25 lbs. (11.3 kg)

Q-VISION HF Control Panel:

Width:	18.7 inches (476.0 mm)
Depth (without stand):	1.9 inches (49.0 mm)
Depth (with stand):	7.125 inches (181.0 mm)
Height:	14.4 inches (365.0 mm)
Weight:	13 lbs. (5.9 kg)

SYSTEM SPECIFICATIONS

System Compatibility:	Compatible with all Quantum Medical Imaging tube stands, overhead tube cranes, radiographic tables and wall stands
Tube Compatibility:	Toshiba Models E7239X, E7242X, E7252X, E7254X, E7255X, E7813X, E7869X Varian Models RAD-8, RAD-13, RAD-14, RAD-21, RAD-44, RAD-56, RAD-60, RAD-68, RAD-74, RAD-92, A192, A272, A292

	Dunlee Models PX 1302, PX 1429, PX 1436, PX 1312, DU 309, DA 1092, MX100 replacement tube for GE Radiographic Systems
	(For tube types not listed, consult factory.)
Collimators:	Huestis Manual, Model 150MC Huestis Automatic, Model 150PBL Huestis Selectable, Model 150A, Progeny Linear MC150 (Manual) Progeny Linear II and Linear IV (Automatic)

Note: *The HF Series radiographic systems are compatible with any automatic collimating system that provides an isolated normally open switch that closes when the Automatic Collimation System presents an "EXPOSURE READY" mode to the control; they are also compatible with any beam limiting device that complies with 21 CFR Subchapter J intended for radiographic equipment.*

POWER REQUIREMENTS

In order to assure the proper operation of our equipment and subsequently, the production of high-quality radiographs, it is essential that all power requirements, as specified in the tables that follow, are suitably met by the facility in which the equipment is installed. This includes usage of the proper size conductor between distribution transformer and disconnect switch, connection to a supply transformer of sufficient capacity (specified in terms of KVA), insuring the AC input voltage tolerance meets specification (±5% or ±10% depending on model), and voltage regulation of 5% at full load is maintained. All wiring and grounding at the installation site must be in accordance with applicable National Electric Code (NEC) and/or local electrical codes.

THe generator requires a 3-phase "Y" connection, measured line-to-line, balanced to earth or neutral. The "Y" connection can be 4-wire (L1, L2, L3, Neutral) and GND or 3-wire (L1, L2, L3) and GND. The 4-wire connection may be required by local electrical code and in connection where a roughly balanced 3-phase source exists (e.g., when using a delta-to-Y transformer).

Note that failure to comply with the above requirements not only may result in improper generator operation and/or performance, but it will also void the warranty, as the warranty is exclusive of the following conditions:

- "Failure of customer to prepare the site or provide power requirements or operating environmental conditions in compliance with any applicable instructions or recommendations of QMI.
- "Failure of customer to provide the proper incoming power required to support the equipment in accordance with the recommendation of QMI.
- "Improper or extraordinary use of the Product, improper maintenance of the Product, or failure to comply with any applicable instructions or recommendations of Quantum Medical Imaging, LLC.

NOTE: *All single-phase x-ray generator input ratings assume the use of a single-phase distribution transformer. When utilizing two legs of a 3-phase transformer, review the National Electrical Code and any applicable local electrical code(s) to ensure the correct rating distribution transformer (in terms of KVA) is used to assure line stability. This configuration would require an increase in the overall power (KVA) of the distribution transformer, depending on whether the input line transformer is Wye or Delta type. Under no circumstances should a Delta type transformer be used for input power to a 3-phase generator.*

SINGLE-PHASE X-RAY GENERATORS

Non-Stored Energy Single-phase x-ray generators require three-wire line inputs in either of the following two configurations:

- one hot wire, one neutral wire, and one earth ground wire
- two hot wires and one earth ground.

Refer to Table 1-1 for power requirements of single-phase (non-stored energy) HF Series Generators.

25 kW Single Phase (Model QG-25)

Line Voltage:	208-260 VAC (±5%), 100 Amps, 50/60 Hz
Momentary Current:	200 Amps (@208VAC)
Long Term Current:	less than 1.0 Amp
Mode of Operation:	Intermittent operation

25 kW Single Phase (Model QG-25-5)*

Line Voltage:	380 - 480 VAC (±10%), 60 Amps, 50/60 Hz
Momentary Current:	110 Amps @ 415 VAC
Long Term Current:	less than 1.0 Amp
Mode of Operation:	Intermittent operation

32 kW Single Phase (Model QG-32)

Line Voltage:	208-260 VAC (±5%), 120 Amps, 50/60 Hz
Momentary Current:	240 Amps (@208VAC)
Long Term Current:	less than 1.0 Amp
Mode of Operation:	Intermittent operation

32 kW Single Phase (Model QG-32-5)*

Line Voltage:	380 - 480 VAC (±10%), 75 Amps, 50/60 Hz
Momentary Current:	140 Amps @ 415 VAC
Long Term Current:	less than 1.0 Amp
Mode of Operation:	Intermittent operation

40 kW Single Phase (Model QG-40)

Line Voltage:	208-260 VAC (±5%), 150 Amps, 50/60 Hz
Momentary Current:	300 Amps (@208VAC)
Long Term Current:	less than 1.0 Amp
Mode of Operation:	Intermittent operation

40 kW Single Phase (Model QG-40-5)*

Line Voltage:	380-480 VAC (±10%), 100 Amps, 50/60 Hz
Momentary Current:	170 Amps @ 415 VAC
Long Term Current:	less than 1.0 Amp
Mode of Operation:	Intermittent operation

32 kW Single Phase, Stored Energy

Line Voltage:	105-130 (±10%), 10 Amps, 50/60 Hz 210-250 VAC (±10%), 10 Amps, 50/60 Hz
Momentary Current:	13 Amps @ 115 VAC 7 Amps @ 230 VAC
Long Term Current:	less than 1.0 Amp
Mode of Operation:	Intermittent operation

40 kW Single Phase, Stored Energy

Line Voltage:	105-130 (±10%), 10 Amps, 50/60 Hz 210-250 VAC (±10%), 10 Amps, 50/60 Hz
Momentary Current:	13 Amps @ 115 VAC 7 Amps @ 230 VAC
Long Term Current:	less than 1.0 Amp
Mode of Operation:	Intermittent operation

50 kW Single Phase, Stored Energy

Line Voltage:	105-130 (±10%), 10 Amps, 50/60 Hz 210-250 VAC (±10%), 10 Amps, 50/60 Hz
Momentary Current:	13 Amps @ 115 VAC 7 Amps @ 230 VAC
Long Term Current:	less than 1.0 Amp
Mode of Operation:	Intermittent operation

Note: *Models QG-25-5, QG-32-5, and QG-40-5 are not UL classified.*

THREE-PHASE X-RAY GENERATORS

Three-phase x-ray generators require three "hot" wires and one earth ground wire. Refer to Tables 1-2 and 1-3 for power requirements of three-phase HF Series Generators.

32 kW Three Phase (Model QG-32-2)

Line Voltage:	208-240 VAC (±5%), 70 Amps, 50/60 Hz
Momentary Current:	140 Amps (@220 VAC)
Long Term Current:	less than 1.0 Amp
Mode of Operation:	Intermittent operation

32 kW Three Phase (Model QG-32-3)

Line Voltage:	380-480 VAC (±10%), 60 Amps, 50/60 Hz
Momentary Current:	117 Amps (@440 VAC)
Long Term Current:	less than 1.0 Amp
Mode of Operation:	Intermittent operation

40 kW Three Phase (Model QG-40-2)

Line Voltage:	208-240 VAC (±5%), 85 Amps, 50/60 Hz
Momentary Current:	170 Amps (@220 VAC)
Long Term Current:	less than 1.0 Amp
Mode of Operation:	Intermittent operation

40 kW Three Phase (Model QG-40-3)

Line Voltage:	380-480 VAC (±10%), 60 Amps, 50/60 Hz
Momentary Current:	125 Amps (@440 VAC)
Long Term Current:	less than 1.0 Amp
Mode of Operation:	Intermittent operation

50 kW Three Phase (Model QG-50-2)

Line Voltage:	208-240 VAC (±5%), 110 Amps, 50/60 Hz
Momentary Current:	220 Amps (@220 VAC)
Long Term Current:	less than 1.0 Amp
Mode of Operation:	Intermittent operation

50 kW Three Phase (Model QG-50-3)

Line Voltage:	380-480 VAC (±10%), 80 Amps, 50/60 Hz
Momentary Current:	144 Amps (@440 VAC)
Long Term Current:	less than 1.0 Amp
Mode of Operation:	Intermittent operation

65 kW Three Phase (Model QG-65)

Line Voltage:	380-480 VAC (±10%), 90 Amps, 50/60 Hz
Momentary Current:	190 Amps (@440 VAC)
Long Term Current:	less than 1.0 Amp
Mode of Operation:	Intermittent operation

80 kW Three Phase (Model QG-80)

Line Voltage:	380-480 VAC (±10%), 100 Amps, 50/60 Hz
Momentary Current:	200 Amps (@440 VAC)
Long Term Current:	less than 1.0 Amp
Mode of Operation:	Intermittent operation

HIGH-SPEED STARTER POWER REQUIREMENTS

A High-Speed Starter (HSS) unit is optional on Models QG-40 and QG-50, and is standard equipment on Models QG-65 and QG-80.

The external HSS (QG-HSS) configuration requires a separate 200 - 240 VAC, 20A line input. Note that a separate 200- 240 VAC line input is ***not required*** on generators equipped with Internal High Speed Starter (Q-HSS) configuration.

Table 1-1. HF Series Generators -
Electrical Wiring Requirements (208 - 260 VAC Single-Phase Input Units)

GENERATOR CATALOG NO.	GENERATOR MODEL NO.	MAX. POWER OUTPUT (kW)	NOMINAL LINE VOLTAGE (VAC)	DISCONNECT TO GENERATOR 15 FT. (5 M) MAX.	*SERVICE RATING	*RECOMMENDED DISTRIBUTION TRANSFORMER CAPACITY	MAX. INPUT LINE RESISTANCE (AT FULL-LOAD RMS)
QG-250	QG-25	25	208	#4 AWG	100 AMPS	30 KVA	0.06 OHMS
			240	#4 AWG	80 AMPS	30 KVA	0.08 OHMS
QG-320, QG-3200, QGV-32	QG-32	32	208	#2 AWG	120 AMPS	40 KVA	0.04 OHMS
			240	#2 AWG	100 AMPS	40 KVA	0.05 OHMS
QG-400, QG-4000, QGV-40	QG-40	40	208	#1 AWG	150 AMPS	50 KVA	0.035 OHMS
			240	#1 AWG	120 AMPS	50 KVA	0.04 OHMS

NOTE: All installations must meet the requirements of local electrical codes.
The above values are recommended as typical (unless otherwise specified).

1. All wire must be copper.
2. Actual wire size depends on power quality and distance between mains power and the generator.
3. All wiring and grounding must be in accordance with National Electric Code (NFPA #70) or local electrical codes.
4. The disconnect switch must be located within reach of the operator.
5. Input Voltage: 208-257 (±5%) VAC 50/60 Hz (configured at time of installation).
6. Line Regulation: 5% at full load.
7. Ground wire size is 4 AWG.
8. Specifications are subject to change.
9. Specifications for single-phase “stored energy” Models QG-20-SE, QG-32-SE, QG-40-SE and QG-50-SE are as follows:
   105-130 VAC (±10%), 10 Amps, 50/60 Hz
   210-250 VAC (±10%), 10 Amps, 50/60 Hz

Table 1-2. HF Series Generators -
Electrical Wiring Requirements (380 - 480 VAC Single-Phase Input Units)

GENERATOR CATALOG NO.	GENERATOR MODEL NO.	MAX. POWER OUTPUT (kW)	NOMINAL LINE VOLTAGE (VAC)	DISCONNECT TO GENERATOR 15 FT. (5 M) MAX.	*SERVICE RATING	*RECOMMENDED DISTRIBUTION TRANSFORMER CAPACITY	MAX. INPUT LINE RESISTANCE (AT FULL-LOAD RMS)
QG-250-5	QG-25-5	**25**	380	#6 AWG	60 AMPS	32 KVA	0.028 OHMS
			415	#6 AWG	55 AMPS	32 KVA	0.028 OHMS
			480	#6 AWG	40 AMPS	32 KVA	0.032 OHMS
QG-320-5, QG-3200-5, QGV-32-5	QG-32-5	**32**	380	#6 AWG	75 AMPS	40 KVA	0.024 OHMS
			415	#6 AWG	70 AMPS	40 KVA	0.024 OHMS
			480	#6 AWG	60 AMPS	40 KVA	0.028 OHMS
QG-400-5, QG-4000-5, QGV-40-5	QG-40-5	**40**	380	#4 AWG	100 AMPS	50 KVA	0.015 OHMS
			415	#4 AWG	90 AMPS	50 KVA	0.020 OHMS
			480	#6 AWG	70 AMPS	50 KVA	0.024 OHMS

***NOTE: All installations must meet the requirements of local electrical codes.**
The above values are recommended as typical (unless otherwise specified).

1. All wire must be copper.
2. Actual wire size depends on power quality and distance between mains power and the generator.
3. All wiring and grounding must be in accordance with National Electric Code (NFPA #70) or local electrical codes.
4. The disconnect switch must be located within reach of the operator.
5. Input Voltage: 380-480 (±10%) VAC 50/60 Hz (configured at time of installation).
6. Ground wire size is 4 AWG.
7. Specifications are subject to change.

Table 1-3. HF Series Generators - Electrical Wiring Requirements (380-480 VAC Three-Phase Input Units)

GENERATOR CATALOG NO.	GENERATOR MODEL NO.	MAX. POWER OUTPUT (kW)	NOMINAL LINE VOLTAGE (VAC)	DISCONNECT TO GENERATOR 15 FT. (5 M) MAX.	*SERVICE RATING	*RECOMMENDED DISTRIBUTION TRANSFORMER CAPACITY	MAX. INPUT LINE RESISTANCE (AT FULL-LOAD RMS)
QG-320, QG-3200, QGV-32-3, QG-400, QG-4000, QGV-40-3	QG-32-3, QG-40-3	32 (QG-32-3) 40 (QG-40-3)	380	#6 AWG	60 AMPS	50 KVA	0.23 OHMS
			440	#6 AWG	60 AMPS	50 KVA	0.33 OHMS
			480	#6 AWG	50 AMPS	50 KVA	0.4 OHMS
QG-500, QG-5000, QGV-50	QG-50	50	380	#4 AWG	80 AMPS	65 KVA	0.17 OHMS
			440	#6 AWG	80 AMPS	65 KVA	0.20 OHMS
			480	#6 AWG	75 AMPS	65 KVA	0.24 OHMS
QG-6500, QGV-65	QG-65	65	380	#4 AWG	90 AMPS	80 KVA	0.12 OHMS
			440	#4 AWG	90 AMPS	80 KVA	0.17 OHMS
			480	#4 AWG	90 AMPS	80 KVA	0.19 OHMS
QG-8000, QGV-80	QG-80	80	380	#4 AWG	100 AMPS	100 KVA	0.10 OHMS
			440	#4 AWG	100 AMPS	100 KVA	0.14 OHMS
			480	#4 AWG	100 AMPS	100 KVA	0.16 OHMS

***NOTE: All installations must meet the requirements of local electrical codes. The above values are recommended as typical (unless otherwise specified).**

1. All wire must be copper.
2. Actual wire size depends on power quality and distance between mains power and the generator.
3. All wiring and grounding must be in accordance with National Electric Code (NFPA #70) or local electrical codes.
4. The disconnect switch must be located within reach of the operator.
5. Input Voltage: 380-480 (±10%) VAC 50/60 Hz (configured at time of installation).
6. Voltage is three-phase Y-configuration, measured line-to-line, balanced to earth ground. (Note: Additional Neutral wire may be used if required by local electrical code.)
7. Ground wire size is 4 AWG.
8. Specifications are subject to change.

Table 1-4. HF Series Generators -
Electrical Wiring Requirements (208-240 VAC Three-Phase Input Units)

GENERATOR CATALOG NO.	GENERATOR MODEL NO.	MAX. POWER OUTPUT (kW)	NOMINAL LINE VOLTAGE (VAC)	DISCONNECT TO GENERATOR 15 FT. (5 M) MAX.	*SERVICE RATING	*RECOMMENDED DISTRIBUTION TRANSFORMER CAPACITY	MAX. INPUT LINE RESISTANCE (AT FULL-LOAD RMS)
QG-320, QG-3200, QGV-32-2	QG-32-2	32	208	#6 AWG	70 AMPS	40 KVA	0.026 OHMS
			240	#6 AWG	60 AMPS	40 KVA	0.023 OHMS
QG-400, QG-4000, QGV-40-2	QG-40-2	40	208	#4 AWG	90 AMPS	50 KVA	0.017 OHMS
			240	#6 AWG	70 AMPS	50 KVA	0.024 OHMS
QG-500, QG-5000, QGV-50-2	QG-50-2	50	208	#4 AWG	110 AMPS	65 KVA	0.014 OHMS
			240	#4 AWG	90 AMPS	65 KVA	0.016 OHMS

***NOTE: All installations must meet the requirements of local electrical codes.**
*** The above values are recommended as typical (unless otherwise specified).**

1. All wire must be copper.
2. Actual wire size depends on power quality and distance between mains power and the generator.
3. All wiring and grounding must be in accordance with National Electric Code (NFPA #70) or local electrical codes.
4. The disconnect switch must be located within reach of the operator.
5. Input Voltage: 208-257 (±5%) VAC 50/60 Hz (configured at time of installation).
6. Voltage is three-phase Y-configuration, measured line-to-line, balanced to earth ground. (Note: Additional Neutral wire may be used if required by local electrical code.)
7. Line Regulation: 5% at full load.
8. Ground wire size is 4 AWG.
9. Specifications are subject to change.

GENERATOR AUXILIARY POWER SUPPLIES

The HF Series X-ray Generator supplies the following supply voltages for powering X-ray room equipment:

- 24 VDC, 1.5A
- 24 VAC, 150W (collimator lamp not to exceed 150W)
- 115 VAC, 3A

NOTE: *The above voltage outputs are not to be used as power sources for collimator lamps or for inductive loads (e.g., motorized tables, solenoids, etc.)*

PERFORMANCE SPECIFICATIONS

Table 1-5 provides performance specifications of single-phase (non-stored energy) HF Series Generators.

Table 1-5. HF Series Single-Phase Generator Performance Specifications

	N/A	**Cat. No. QG-3200, QGV-32**	**Cat. No. QG-4000, QGV-40**
	N/A	**Models QG-32, QG-32-5**	**Models QG-40, QG-40-5**
Maximum kW	N/A	32	40
mA Stations; Small Focus (S) Large Focus (L)	N/A	25S, 75S, 150S 100L, 200L, 250L, 320L, 400L, 500L	25S, 75S, 150S 100L, 200L, 250L, 320L, 400L, 500L
kVp Range (kVp)	N/A	40-125	40-125
kVp increments (kVp/step)	N/A	1.0	1.0
150 kVp option	N/A	Yes	Yes
Time Range (sec.)*	N/A	0.001 - 6.3	0.001 - 6.3
Minimum Exposure Time (sec.)	N/A	0.001	0.001
mAs Range†	N/A	0.025-600	0.025-600
High-SpeedStarter	N/A	No	No
Ripple Voltage (output)	N/A	5%	5%

* *Time measured at 75% of the peak kVp waveform*
NOTE: AEC TECHNIQUES SHOULD HAVE EXPOSURE TIMES EXCEEDING 8 MILLISECONDS.

† *mAs is tube dependent*

Refer to Table 1-6 for performance specifications of single-phase stored energy (SE) HF Series Generators.

Table 1-6. HF Series Single-Phase STORED ENERGY Generator Performance Specifications

	N/A	Cat. No. QG-3200-SE, QGV-32-SE	Cat. No. QG-4000-SE, QGV-40-SE	Cat. No. QG-5000-SE, QGV-50-SE
	N/A	Model QG-32-SE (STORED ENERGY)	Model QG-40-SE (STORED ENERGY)	Model QG-50-SE (STORED ENERGY)
Maximum kW	N/A	32	40	50
mA Stations; Small Focus (S) Large Focus (L)	N/A	25S, 50S, 75S, 150S 100L, 160L, 200L, 250L, 320L, 400L	25S, 50S, 75S, 150S 100L, 200L, 250L, 320L, 400L, 500L	25S, 50S, 75S, 150S 100L, 200L, 250L, 320L, 400L, 500L, 600L
kVp Range (kVp)	N/A	40-125	40-125	40-125
kVp increments (kVp/step)	N/A	1.0	1.0	1.0
150 kVp optional?	N/A	No	No	No
Time Range (sec.)*	N/A	0.001 - 6.3	0.001 - 6.3	0.001 - 6.3
Minimum Exposure Time (sec.)*	N/A	0.001	0.001	0.001
mAs Range‡	N/A	0.025-400	0.025-500	0.025-500
High-Speed Starter	N/A	No	No	No
Ripple Voltage (output)	N/A	5%	5%	5%

* *Maximum exposure time is a function of kV and mAs settings and the age of the batteries; Time measured at 75% of the peak kVp waveform*
NOTE: AEC TECHNIQUES SHOULD HAVE EXPOSURE TIMES EXCEEDING 8 MILLISECONDS.

‡ *mAs is tube dependent; the generator may not reach maximum mAs due to tube type. In AEC mode, the mAs is limited to 600.*

Refer to Table 1-7 for performance specifications of three-phase HF Series Generators.

Table 1-7. HF Series Three-Phase Generator Performance Specifications

	Cat. No. QG-3200-2, QG-3200-3 QGV-32-2, QGV-32-3	Cat. No. QG-4000-2, QG-4000-3 QGV-40-2, QGV-40-3	Cat. No. QG-5000-2, QG-5000-3 QGV-50, QGV-50-2	Cat. No. QG-6500, QGV-65	Cat. No. QG-8000, QGV-80
	Model Model QG-32-2, QG-32-3	Model Model QG-40-2, QG-40-3	Model QG-50-2, QG-50	Model Model QG-65	Model Model QG-80
Maximum kW	32	40	50	65	80
mA Stations; Small Focus (S) Large Focus (L)	25S, 75S, 150S 100L, 200L, 250L, 320L, 400L, 500L	25S, 75S, 150S 100L, 200L, 250L, 320L, 400L, 500L	25S, 75S, 150S 100L, 200L, 320L, 400L, 500L, 650L	25S, 75S, 150S 100L, 200L, 320L, 400L, 500L, 650L, 800	25S, 75S, 150S 100L, 200L, 320L, 400L, 500L, 650L, 800
kVp Range (kVp)	40-125	40-125 (40-150 with QG-150 option)	40-125 (40-150 with QG-150 option)	40-150	40-150
kVp increments (kVp/step)	1.0	1.0	1.0	1.0	1.0
150 kVp optional?	Yes	Yes	Yes	Standard	Standard
Time Range (sec.)*	0.001 - 6.3	0.001 - 6.3	0.001 - 6.3	0.001 - 6.3	0.001 - 6.3
Minimum Exposure Time (sec.)	0.001	0.001	0.001	0.001	0.001
mAs Range†	0.025-600	0.025-600	0.025-800	0.025-800	0.025-800
High-Speed Starter‡	No	Option	Option	Yes	Yes
Ripple Voltage (output)	5%	5%	5%	5%	5%

* *Time measured at 75% of the peak kVp waveform*
NOTE: AEC TECHNIQUES SHOULD HAVE EXPOSURE TIMES EXCEEDING 8 MILLISECONDS.

† *mAs is tube dependent; the generator may not reach maximum mAs due to tube type. In AEC mode, the mAs is limited to 600.*

‡ *High-Speed Starter Duty Cycle: do not to exceed two activations within any one minute period*

Table 1-8. Accuracy Specifications

Accuracy Specifications		
kVp Accuracy:		kVp = ± (4.0% kV)
mA Accuracy:		mA = ± (5.0% mA + 1 mA)
Time Accuracy:	If: 1 msec. ≤ time ≤ 50 msec., If: 50 msec. < time ≤ 100 msec., If: 100 msec. < time ≤ 6300 msec.,	time = ± (2.0% time + 1 msec.) time = ± (1.0% time + 1 msec.) time = ± (0.5% time + 1 msec.)
mAs Accuracy:		mAs = ± (5.0% mAs + 0.5 mAs)

SYSTEM OPTIONS

The following lists the available options for HF Series X-Ray Generators. Note that some options, such as QG-150 and Q-HSS, may only be used on certain generator models (refer to Tables 1-5 through 1-7 for compatibility):

- R80-HS: Exposure Hand Switch and R80-FS Foot Switch
- QG-PDL: Operator Control Panel Pedestal Mount (used with ODYSSEY control panel)
- QG-WM: Operator Control Panel Wall Mount (used with ODYSSEY control panel)
- QGV-WM: Operator Control Panel Wall Mount (used with Q-VISION control panel)
- QG-150: 150 kV High Voltage Transformer (standard equipment on Models QG-65 and QG-80)
- Q-HSS: Internal High (Dual) Speed Starter Unit (standard equipment on Models QG-65 and QG-80
- Q-Connect: Enables ethernet connection to a PC computer using Quantum's "QBus" network integration software; required on systems utilizing a touch-screen operator control panel
- QG-28VPS: Internally mounted Auxiliary +28 VDC/8A Power Supply (only available with three-phase input generators)
- QG-TOMO: Provides interface for operation with Siemens and Pausch tomographic systems (not available with Q-VISION HF Series OCP's)
- TechVision: Supplementary x-ray control panel, mounts on tube support device. Refer to the TechVision Remote Control Panel Service and Operator's Manuals for complete installation and operation instructions.

NOTE: *The use of ACCESSORY equipment not complying with the equivalent safety requirements of this equipment may lead to a reduced level of safety of the resulting system. Consideration relating to the choice shall include:*

-use of the accessory in the PATIENT VICINITY

-evidence that the safety certification of the ACCESSORY has been performed in accordance with the appropriate IEC 601-1 and/or IEC 601-1-1 harmonized national standard.

SYSTEM OPERATING ENVIRONMENT

Ambient Temperature:	+10°C to +40°C
Relative Humidity:	30 to 75%, non-condensing
Atmospheric Pressure:	700 hPa to 1060 hPa
Typical Heat Output of Generator Cabinet:	3600 BTU per hour
Typical Heat Output of operator control panel (OCP):	130 BTU per hour

NOTE: *The above calculations are typical, based upon average usage. Air circulation around the electronic cabinet must be provided. This includes the sides, back, front and top of cabinet.*

NON-OPERATING ENVIRONMENT

Ambient Temperature:	-18°C to +70°C
Relative Humidity:	20 to 95%, non-condensing
Atmospheric Pressure:	500 hPa to 1060 hPa

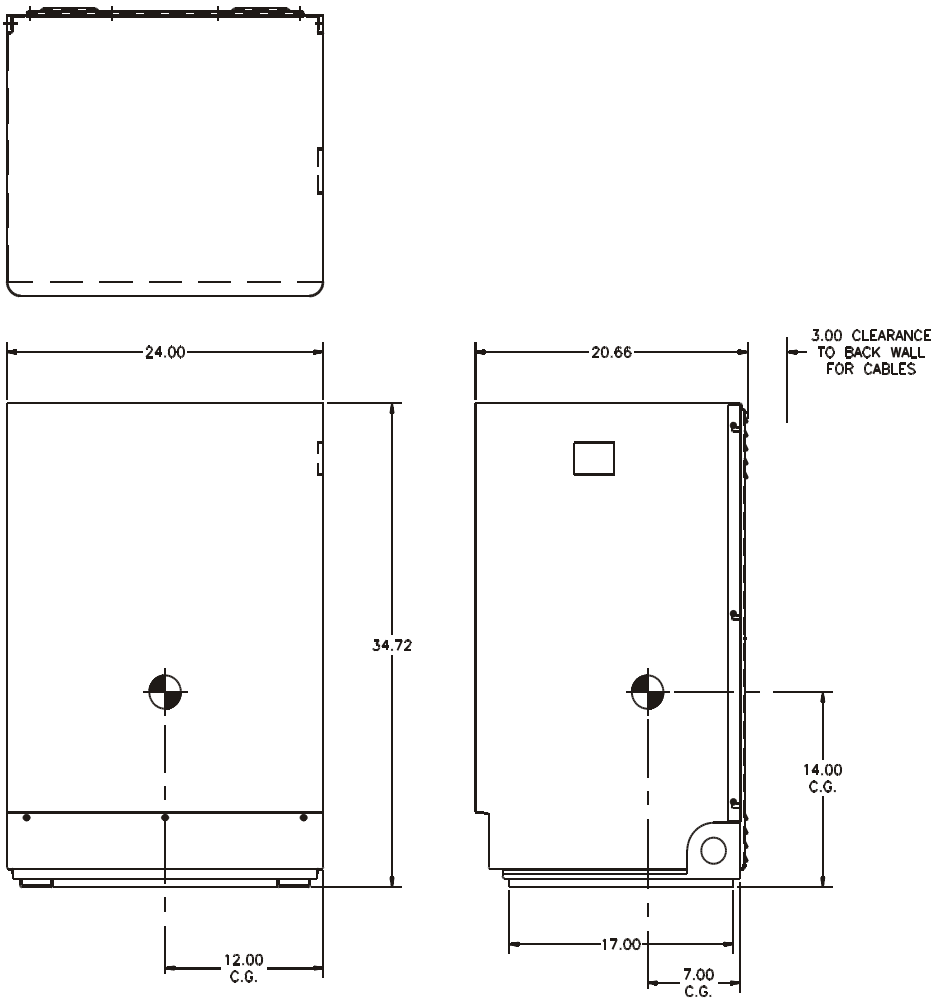


Figure 1-1. HF Series X-ray Generator Cabinet Dimensions

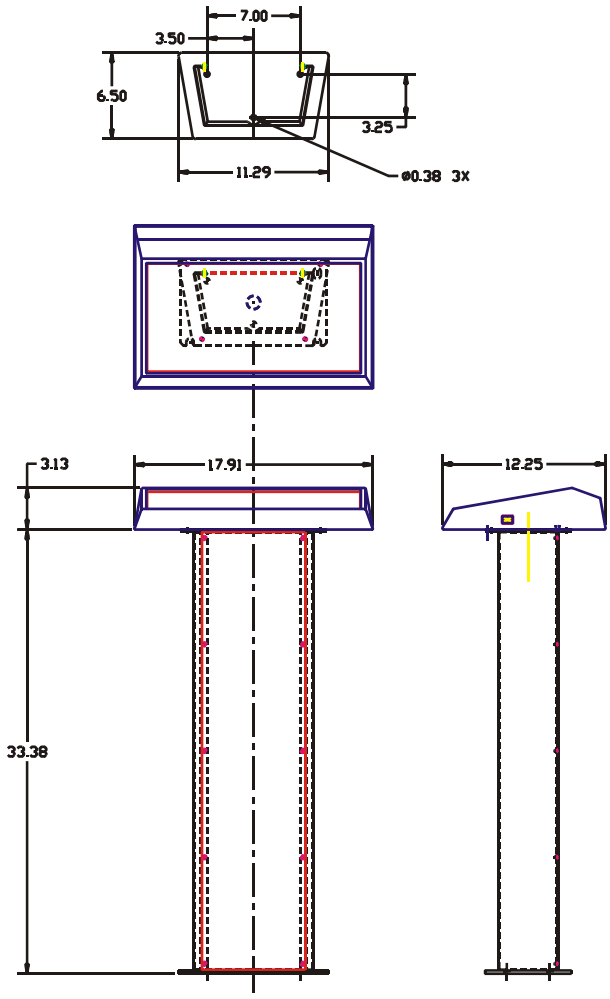


Figure 1-2. Odyssey HF Series X-ray Generator Operator Control Panel Dimensions

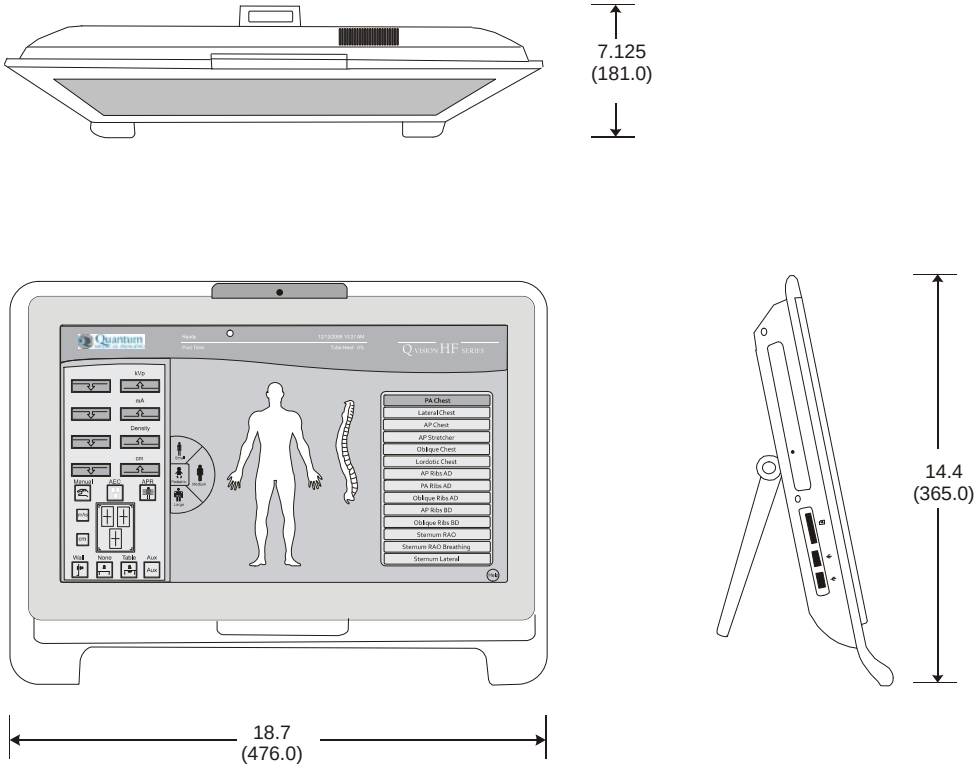


Figure 1-3. Q-VISION HF Series X-Ray Generator Operator Control Panel Dimensions

Chapter 2

ASSEMBLY & INSTALLATION

Chapter 2 Assembly & Installation

OVERVIEW

This chapter provides procedures for installing the HF Series x-ray generator, from pre-installation guidelines to final system inspection prior to operational readiness. These procedures should be reviewed carefully before beginning the actual installation. Preparing the X-ray generator for operation requires completion of the following tasks:

- Installing the X-ray generator cabinet
- Installing the Operator Control Panel (OCP)
- Making the Electrical Cable Connections
- Power-up
- Calibrating the generator
- Inspecting the system
- Verifying programmed techniques

WARNING! Equipment installation and servicing procedures should be performed by properly trained and qualified service personnel only.

PRE-INSTALLATION GUIDELINES

While site planning is the customer's responsibility, the following are recommended guidelines.

Verify Equipment Location

In radiology site preparation, it is essential to verify the location and space allocated for the equipment is sufficient. See Figures 1-1 through 1-3 for HF Series x-ray generator dimensions. The room plan should show the following for the equipment:

- All working and parked positions
- Overall dimensions
- Total equipment weights and power outputs
- Structural mounting and attachment methods

Ensure sufficient air circulation space is provided between the rear side of Generator Cabinet and wall (4.0" min.). The floor where the generator is installed should be flat and approximately level (minor shimming is acceptable) and capable of supporting a load of 500 lbs. (226.8 kg).

If the generator is equipped with the "Q-Connect option" (ethernet adapter for connection to Q-VISION or for integration with a Digital Radiographic System), the associated computer monitor functions as the generator operator control panel (OCP). If the workstation is qualified to standard UL 60950/IEC

60950 for Information Technology Equipment, the workstation must be placed outside the radius of the patient environment, shown in Figure 2-1. Only devices conforming to UL 60601-1/IEC 60601-1 may be placed within this environment. Consult with the user of the system when determining the location for the workstation computer; consider all areas the patient may access, including the room entrance and/or exit, when establishing the patient environment.

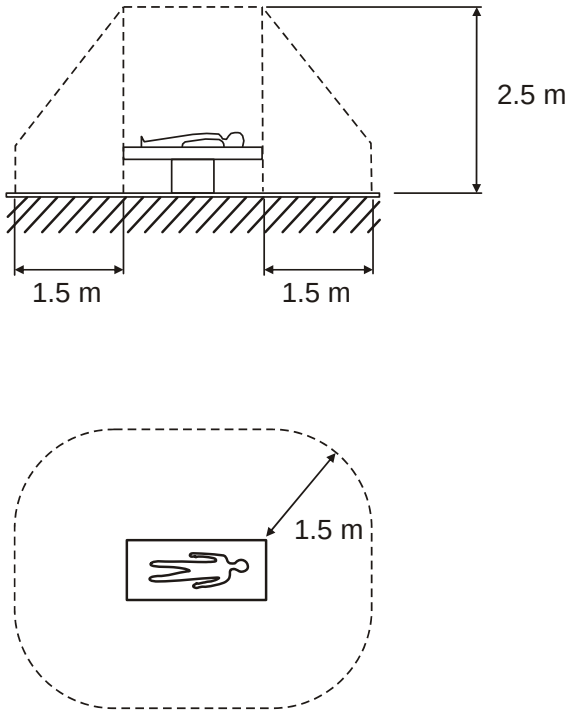


Figure 2-1. Patient Environment

NOTE

Examine all cartons and crates carefully at time of delivery. If damage is apparent, have delivery driver write a "Damaged Shipment Note" on copies of freight bill, sign it, and file appropriate carrier claim. Should you discover concealed damage, immediately notify the transporting agent and ask for an "Inspection of Damage". Carrier will not accept concealed damage claim if filed after 15 days from date of receipt of merchandise.

Electrical Requirements

In addition to providing for the physical requirements of the equipment, it is also vital to prepare for the power requirements. Refer to Chapter 1, SPECIFICATIONS for model-dependent power specifications. This information should be used to prepare system wiring and cabling.

UNPACKING

The HF Series x-ray generator is shipped in a single crate. To unpack, proceed as follows:

1. Remove packing list and use it as a guide to open the remaining cartons. Do not dispose of packing material until packing list is matched with actual parts received. Should there be a shortage or damage, notify Quantum Medical Imaging, LLC.'s customer service department immediately. The manufacturer is relieved of any responsibility for damage during shipment after unit is picked up by the carrier.

WARNING! The X-ray generator cabinet can weigh as much as 430 lbs. (195 kg), depending on configuration. Use lifting straps and hoist or other suitable lifting device to transport generator. The H.V. Tank weighs approximately 100 lbs. and requires two persons to lift.

2. Remove the Generator Cabinet from its crate (lifting straps and hoist or other suitable lifting device is recommended).
3. Using a hand truck from the rear side of the cabinet, lift the generator and place it as close to its final installation location as possible.

WARNING! When unpacking the generator; keep upright at all times. Verify there is no damage caused during shipping, with no apparent oil leakage from H.V. Tank; check that the tank lid and oil plug (in tank lid) are secure.

4. Locate the OCP and Pedestal (optional) or Wall Mount Bracket (optional) and place on the side (not applicable on Q-VISION equipped systems or with integrated systems (e.g., Agfa, Canon, etc.).

INSTALLATION

The following paragraphs provide information necessary for installing the Generator Cabinet and Operator Control Panel (OCP), including all required external equipment cable connections with the X-ray generator.

CAUTION! This equipment contains electrostatic sensitive devices. Observe proper grounding precautions before handling components or printed circuit boards.

REQUIRED TOOLS AND MATERIALS

The following lists the tools and materials required to perform the procedures included in this chapter:

- Hoist with lifting straps (or other suitable lifting device)
- Tape measure
- Standard hand tools
- Drill bit, suitable size for installing floor mounting hardware
- Bubble level
- Various wiring connectors and cable ties

GENERATOR CABINET SETUP

1. Loosen six (6) phillips head screws (3 each on left and right sides of cabinet) and remove three (3) phillips head screws (in lower front side) securing generator cabinet cover to generator chassis (see Figure 2-1a). Grasp cover on each side, lift up slightly and remove.

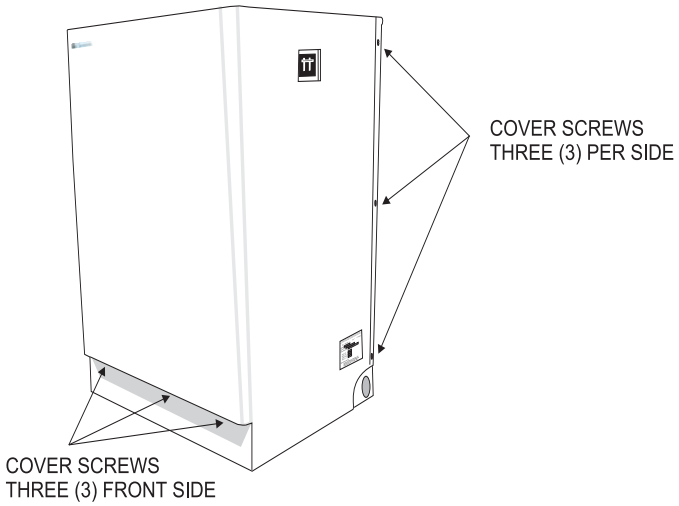


Figure 2-1a. Generator Cabinet Cover Screw Locations

WARNING! Approximately 200 VDC is present on each battery tray. This voltage is live even when generator cabinet power switch is set to OFF. Use extreme caution when servicing battery tray(s).

2. On stored energy (SE) units, open the two (2) modular fuse holders located on the front of each battery tray. Note that there are two pairs of fuses on 32 kW and 40 kW units, one pair for each battery tray.
3. If mounting generator to floor, mark locations of the four mounting holes on floor in accordance with dimensions given in Figure 2-2. Drill four holes using proper diameter drill bit (depending on mounting hardware used).

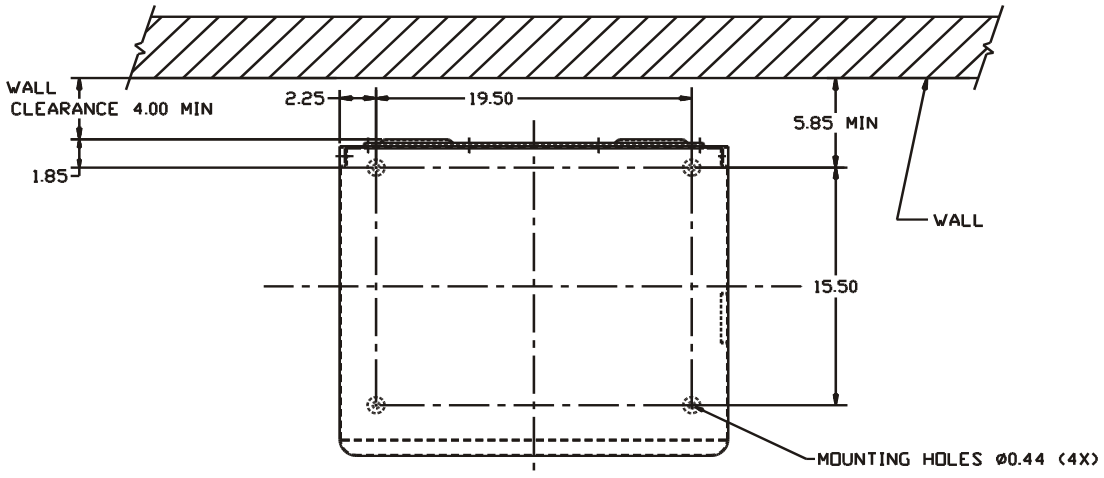


Figure 2-2. Generator Cabinet Mounting Hole Locations

4. Position the generator chassis in its mounting location and place a level on flat horizontal surface of chassis. If chassis is not level, add shim(s) below generator as required until level.
5. After all cable connections that require access to the rear of the generator are complete, secure cabinet to floor using 3/8" diameter mounting hardware suitable for floor construction type.

Transformer Line Tap Adjustment (Single Phase Non-SE Systems)

WARNING! Extreme care MUST be exercised to ensure the safety of service or other personnel in the area when working with live AC mains.

Proceed as follows:

1. Using a calibrated DVM, measure the AC input (mains) voltage (i.e., line-to-line or line-to-neutral, when applicable).
2. Verify that power to x-ray generator is disconnected.
3. Adjust transformer taps by relocating the leads on the top side of transformer terminal block TB2 to match the input line voltage as closely as possible. Refer to Figure 2-3 for 208 - 260 VAC single-phase input line tap configurations, and Figure 2-4 for 380 - 480 VAC single-phase input line tap configurations.

NOTE
STORED ENERGY (SE) models can operate between 105 and 130 VAC and non-SE, single-phase models between 200 and 270 VAC. Refer to Chapter 1, SPECIFICATIONS.

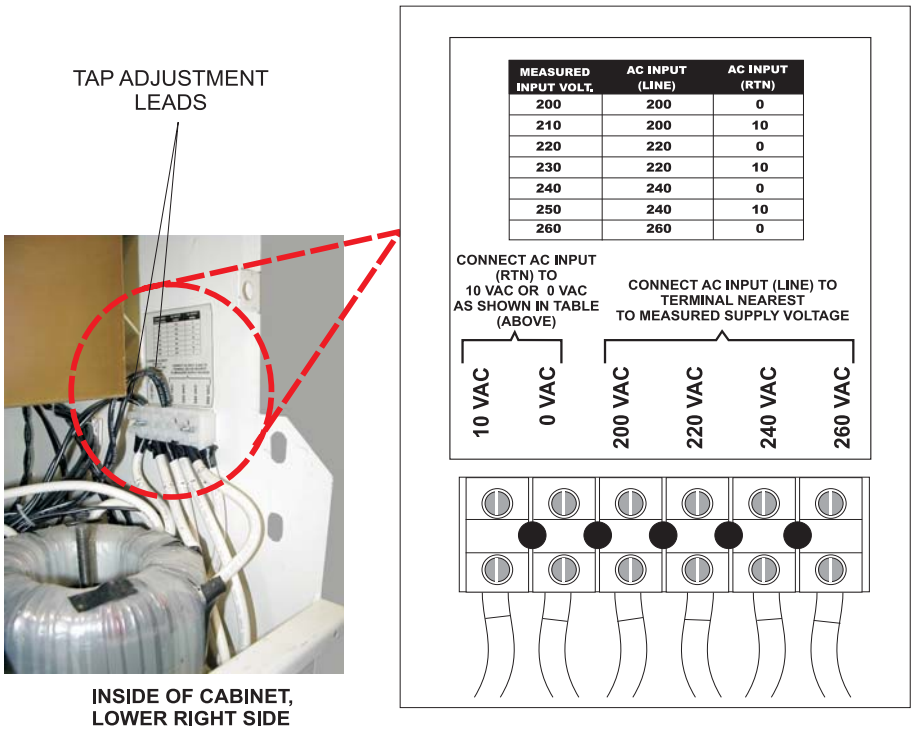


Figure 2-3. Single-Phase 208 - 260 VAC Single-Phase Input AC Transformer Line Tap Connections

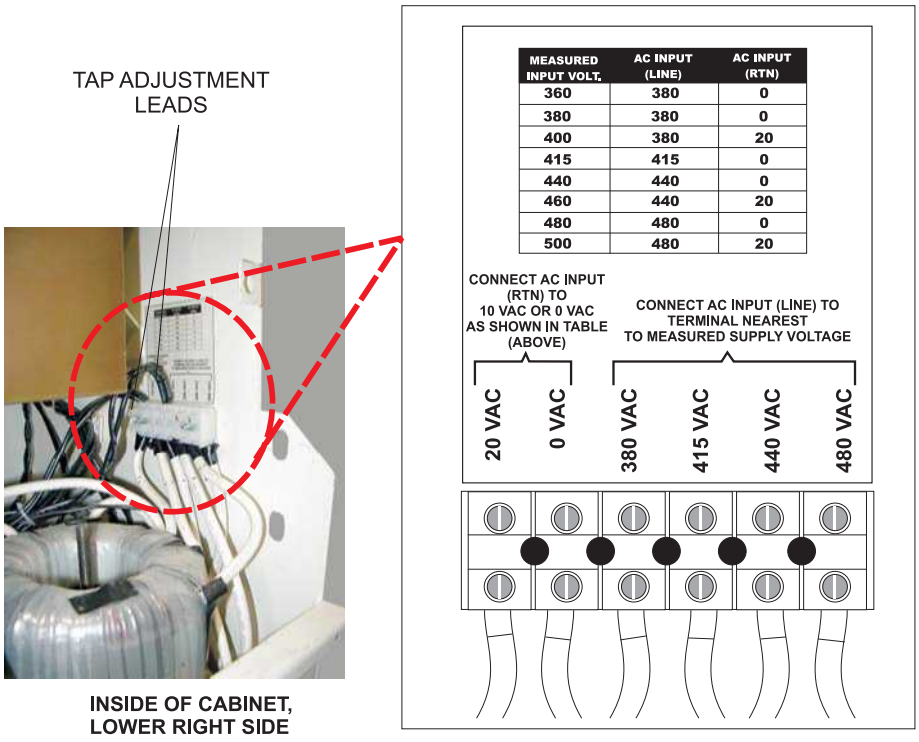


Figure 2-4. Single-Phase 380 - 480 VAC Single-Phase Input AC Transformer Line Tap Connections

4. For single-phase non-SE models, it is necessary to insure that the line resistance meets the maximum allowed as stated in Chapter 1, SPECIFICATIONS. If line resistance exceeds the specification, the generator must be derated. Refer to Chapter 3, CALIBRATION for derating instructions.

5. Verify Line Monitor Board A8 "line input jumper" is configured correctly based on the installation site's measured line input voltage as follows:

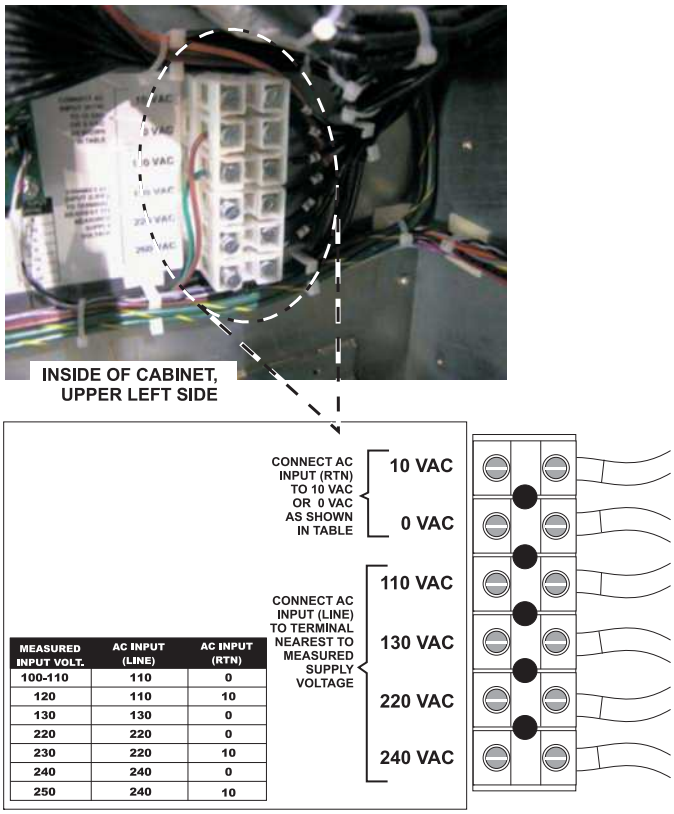
   a. For 208 - 260 VAC input models (QG-25, QG-32 and QG-40), refer to Line Monitor Board A8 (AY40-022T1) Test Point/Jumper Location Diagram in Chapter 6, DIAGRAMS and, if necessary, set "line input" jumpers to match the line input supply voltage (i.e., 208 - 260 VAC, three "240" jumpers are installed). Also, for 208 - 260 VAC line input configurations, fuses A8F1 and A8F3 should be 1/2A.

   b. For 380 - 480 VAC input models (QG-25-5, QG-32-5 and QG-40-5), refer to Line Monitor Board A8 (AY40-022T2) Test Point/Jumper Location Diagram in Chapter 6, DIAGRAMS and, if necessary, set "line input" jumpers to match the line input supply voltage (i.e., for 342-403 VAC input, install jumper"380"; for 404-459 VAC input, install jumper "430"; for 460-528 VAC input, install jumper "480"). Also, for 380 - 480 VAC line input configurations, fuses A8F1 and A8F3 should be 1/4A.

Transformer Line Tap Adjustment (Single Phase SE Systems)

WARNING! Extreme care MUST be exercised to ensure the safety of service or other personnel in the area when working with live AC mains.

1. Using a calibrated DVM, measure the AC input (mains) voltage (i.e., line-to-line or line-to-neutral, when applicable).
2. Verify that power to x-ray generator is disconnected.
3. Adjust transformer taps by relocating the leads on the left side of transformer terminal block TB1 to match the input line voltage as closely as possible. Refer to Figure 2-5 for STORED ENERGY (SE) input line tap configurations.
6. Refer to Line Monitor/Battery Charger Board A8 (AY40-028T) Test Point/ Jumper Location Diagram in Chapter 6, DIAGRAMS and verify "line input" jumpers are configured to match the line input supply voltage (115 or 230 VAC). Also, for 115 VAC line input configurations, fuses A8F5 and A8F7 should be 2A; for 230 VAC line input configurations, these fuses should be 1A.


INSIDE OF CABINET, UPPER LEFT SIDE
CONNECT AC INPUT (RTN) TO 10 VAC OR 0 VAC AS SHOWN IN TABLE
10 VAC
0 VAC
CONNECT AC INPUT (LINE) TO TERMINAL NEAREST TO MEASURED SUPPLY VOLTAGE
110 VAC
130 VAC
220 VAC
240 VAC

MEASURED INPUT VOLT.	AC INPUT (LINE)	AC INPUT (RTN)
100-110	110	0
120	110	10
130	130	0
220	220	0
230	220	10
240	240	0
250	240	10

Figure 2-5. STORED ENERGY Input AC Transformer Line Tap Connections

WARNING! Extreme care MUST be exercised to ensure the safety of service or other personnel in the area when working with live AC mains.

Proceed as follows:

1. Using a calibrated DVM, measure the AC input (mains) voltage (i.e., line-to-line).
2. Verify that power to x-ray generator is disconnected.
3. Adjust transformer taps by relocating the leads on the top side of transformer terminal block TB2 to match the input line voltage as closely as possible. Refer to Figure 2-6 for input line tap configurations.

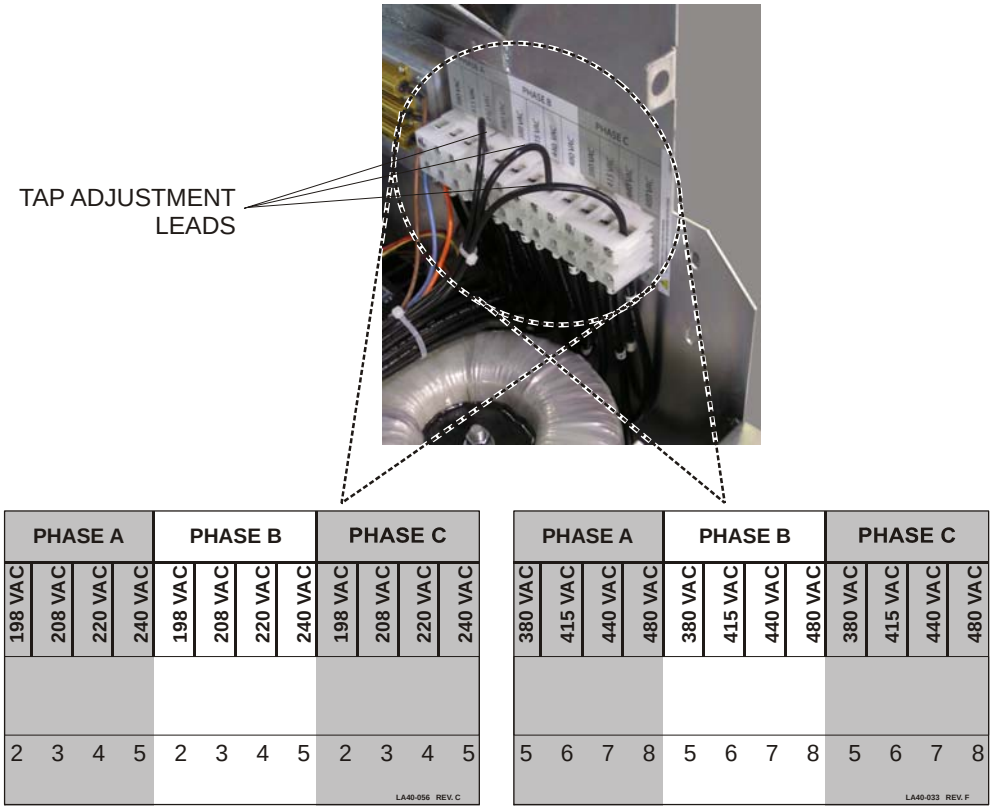


Figure 2-6. Three-Phase Input AC Transformer Line Tap Connections

4. For three-phase models, it is necessary to insure that the line resistance meets maximum allowed as stated in Chapter 1, SPECIFICATIONS. If line resistance exceeds the specification, the generator must be derated. Refer to Chapter 3, CALIBRATION for derating instructions.

5. On Line Monitor Board A8 (part number AY40-053S2 used on 380-480 VAC line input configuration, part number AY40-053S3 used on 208-240 VAC line input configuration), verify 380/430/480 jumper is configured correctly based on incoming line voltage measurement as follows (see Line Monitor Board A8 Chapter 6, DIAGRAMS):

AC INPUT VOLTAGE (MEASURED)	JUMPER POSITION
342-403 VAC	380
404-459 VAC	430
460-528 VAC	480
198-252 VAC	240 (3 jumpers)

AC Input (Mains) Connection

WARNING! Verify incoming power supply (mains disconnect) is turned OFF and all mains cables are de-energized before connecting to the generator.

All electrical connections must be made in compliance with local and/or NEC requirements. The generator is factory configured to accept line input specified when the order was placed. However, if it is necessary to change the generator line input configuration, refer to the previous procedure entitled "Transformer Line Tap Adjustment".

Non-STORED ENERGY (SE) version generators require a mains disconnect box (with switch) before the x-ray generator (refer to your local code). This switch should be within reach of the operator. A separate earth ground, #6 AWG insulated wire, must be installed. This wire must be the only wire connected to the generator ground terminal.

For non-SE generators, connect AC input cable as follows:

1. Mount cable clamp (included with system) to the hole on the lower right or left side of generator cabinet chassis (see Figure 2-7).

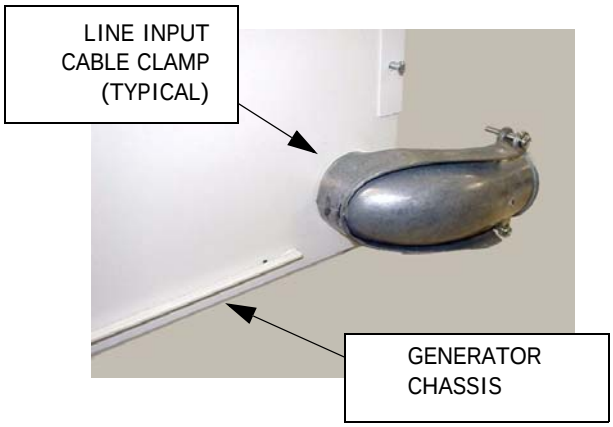


Figure 2-7. Line Input Cable Clamp Installation

2. Route the AC input cable through cable clamp to Terminal Block TB1 and tighten cable clamp.
3. On single-phase systems:
   a. Connect ground wire to ground lug mounted on rear wall of generator chassis, to the left of terminal block TB1 (see Figure 2-8).

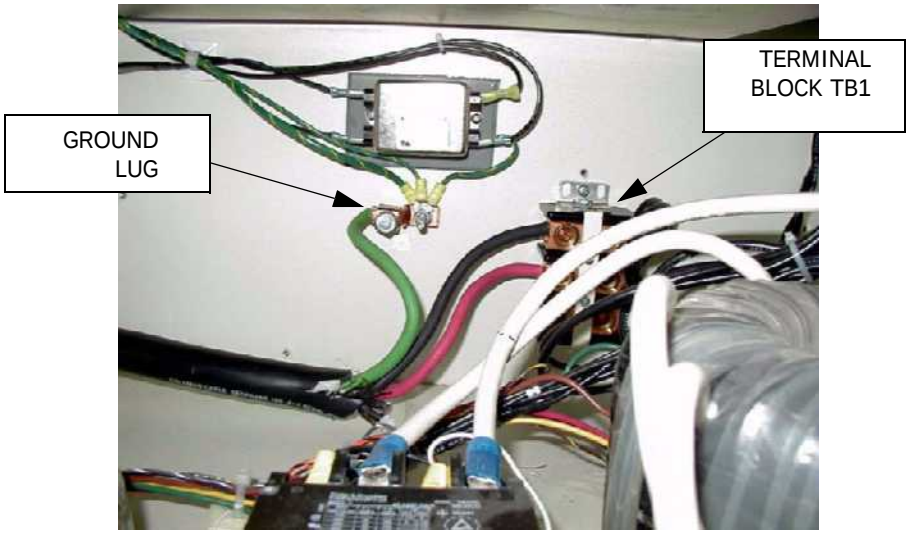


Figure 2-8. Single-Phase Systems - Ground Lug and Terminal Block TB1 Locations

b. Connect mains line and neutral wires to TB1 terminals L1 and L2, respectively. **Do not turn mains power on at this time**.

4. On three-phase systems:

   a. Connect Phase A, B and C wires to TB1 terminals L1 through L3, respectively. **Do not turn mains power on at this time**. (See Figure 2-9).

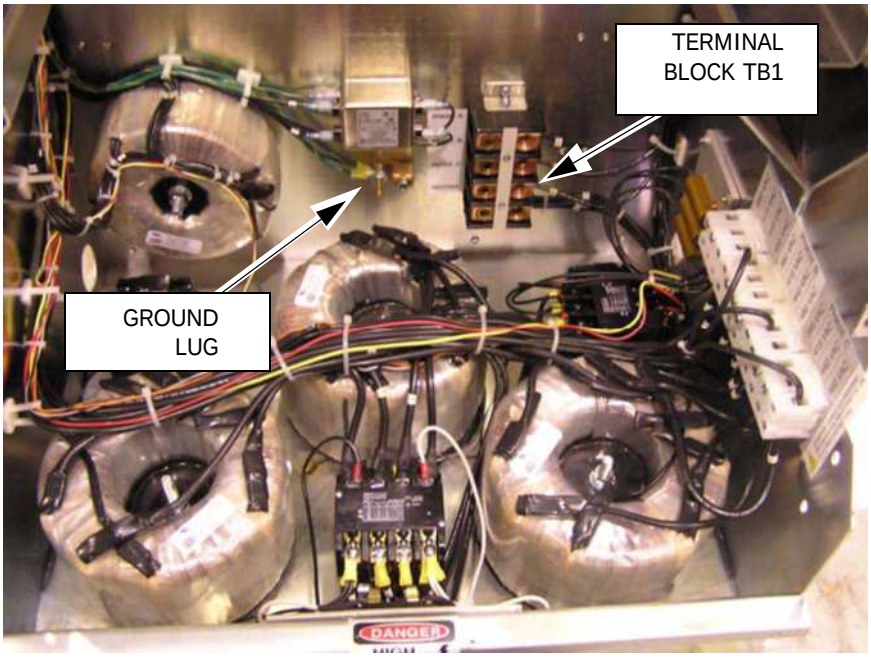


Figure 2-9. Ground Lug and Terminal Block TB1 Locations

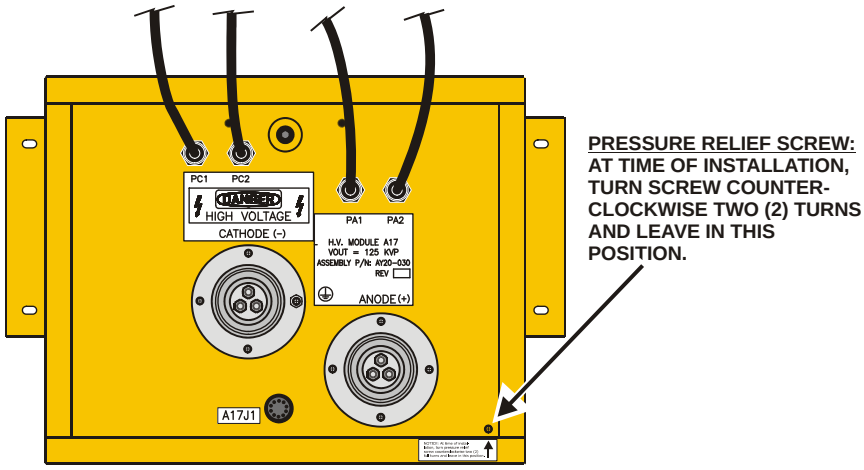
   b. If available, connect Neutral wire to TB1 terminal L4 (N). (Neutral connection may be required; check local electrical code.)

5. On STORED ENERGY (SE) type generators, the battery tray fuse(s) are shipped in the non-inserted position to minimize battery discharge and high voltage hazards. With fuse in holder, close the fuse holder(s). The SE system can be plugged into a standard switched 115/230 VAC grounded receptacle. The switch controlling the receptacle should be within reach of the operator control console. For 115 VAC installations, a 25-foot power cord with a hospital-grade plug is factory pre-wired to the generator. For 230 VAC installations, a 25-foot "HAR" power cord is factory pre-wired to the generator.

   If power cord is replaced, ensure that impedance between the protective contact in the mains plug and any accessible metal part which is protectively earthed does not exceed 0.1 Ohms.

High Voltage (H.V.) Tank

The HF Series X-ray Generator is shipped with the H.V. Tank installed at the factory. Locate the Pressure Relief Screw on the top side of the H.V. Tank near the front right corner (see Figure 2-10). To permit venting, loosen screw two (2) turns (counterclockwise) and leave in this position.



HV TANK (TOP VIEW)

Figure 2-10. H.V. Tank (Top View)

The following instructions are provided should it be necessary to install the H.V. Tank. When installing the H.V. Tank, keep it upright at all times. See Figure 2-11 and proceed as follows:

WARNING! After completing the following procedure, double-check the H.V. Tank wiring connections to make sure they are correctly connected. Incorrect wiring can cause damage to the generator. Ensure that ground wires are connected.

CAUTION! The H.V. Tank weighs approximately 92 lbs. (41.7 kg). Lift with proper assistance.

1. Loosen four (4) screws securing the clear plastic high-voltage acrylic protection panel from the generator chassis and remove panel.
2. Position H.V. Tank on Tank Mounting Brackets so mounting holes in tank align with those in mounting brackets. Secure tank to brackets using four (4) 1/4-20 x 3/4" hex head screws, flat washers and lock washers.
3. Connect H.V. Tank cable terminal PC1 to Power Module A19 IGBT lower right terminal. Tighten screw securely.
4. Connect H.V. Tank cable terminal PC2 to right terminal lug on Capacitor C7. Tighten nut securely.
5. Connect H.V. Tank cable terminal PA1 to left terminal lug on Capacitor C4. Tighten nut securely.
6. Connect H.V. Tank cable terminal PA2 to Power Module A18 lower left IGBT terminal. Tighten screw securely.
7. Locate ground wires for H.V. Tank (yellow/green) and securely fasten to H.V. Tank ground stud (GND) using 8/32 kep nut (provided on stud).
8. Insert plug A17P1 (16-pin plug on Cable Assembly AY51-017) into connector A17J1 on the H.V. Tank and tighten plug securely.
9. Re-install the clear plastic high-voltage protection panel on the generator chassis and re-tighten four (4) mounting screws.

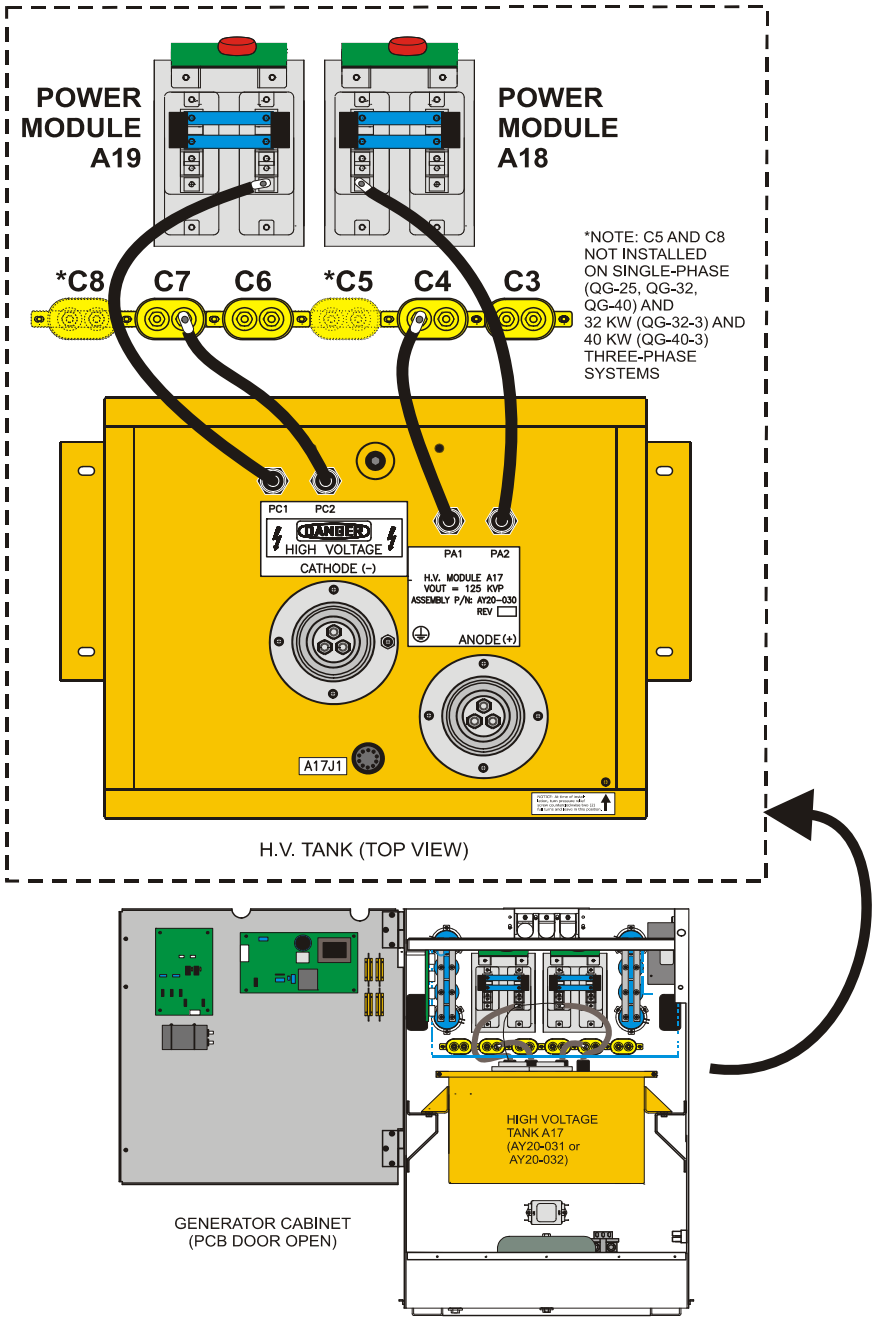


Figure 2-11. H.V. Tank Connections

High Voltage Cables

It is important that these instructions be followed for the proper installation of the High Voltage Cable terminals into the tube housing and H.V. Tank receptacles. Use proper handling to ensure cable terminals and receptacles are clean and free of moisture. Connect High Voltage Cables, respecting proper anode and cathode polarity, as follows:

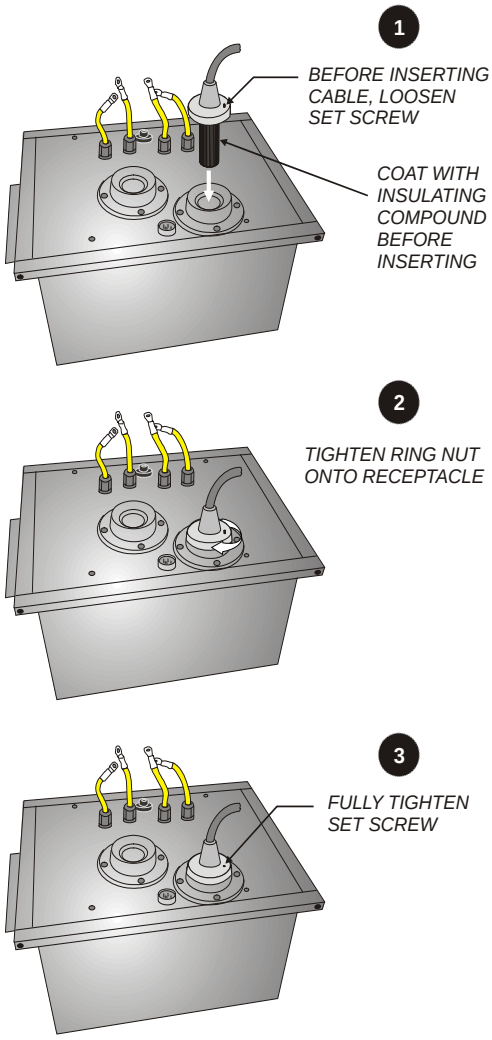
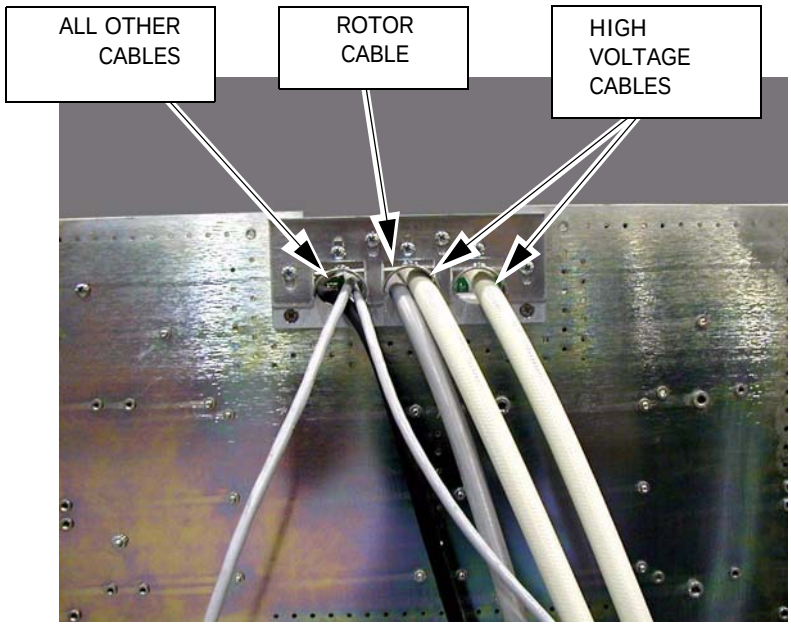


Figure 2-12. High Voltage Cable Connection to H.V. Tank

CAUTION! When routing the High Voltage Cables into the generator cabinet through the access openings, the anode and cathode cable must each be routed separate from all other system cables, except the Tube Rotor Cable, as shown in Figure 2-13. Doing so will reduce the possibility of electromagnetic noise coupling and subsequent degradation of system performance.



GENERATOR CABINET (VIEWED FROM REAR)

Figure 2-13. Routing High Voltage Cables into the Generator Cabinet

1. If not already done so, assemble onto the High Voltage Cable end a cable retaining nut, grounding washer and strain relief (see Figure 2-14). Ensure the 10-32 x 1/4" locking screw is turned out so as not to interfere with engagement.

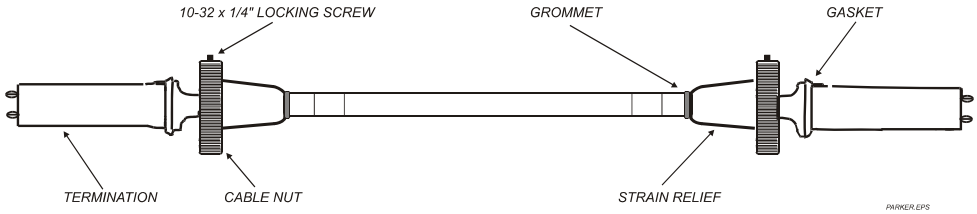


Figure 2-14. High Voltage Cable Assembly (Typical)

2. The High Voltage Cable terminals and tube housing and H.V. Tank receptacles must be clean and dry. Be sure compression gaskets are in place on the cable terminal.
3. To insure proper locking and grounding of the cable sheath, do not omit the compression gasket on the cable terminal, as it is necessary for proper contact between cable nut and flare.
4. Insert the cable terminal into the receptacle socket (watch the nipple on the terminal to ensure correct positioning of the contact pins). **Coat the entire surface of the cable terminal insulator with insulating compound (supplied with cables) using clean, dry plastic spoon or wooden stick.** Do not use fingers. Fully cover the entire surface with a heavy coat (approximately 1/16" to 1/8"). Build a pyramid at the tip of the terminal with the height of the compound even with the contact ends.
5. With terminal key aligned with receptacle key way, insert the cable terminal into receptacle until all excess compound has oozed out. Make sure the contact pins are engaged in the holes in the socket insulator. Wipe off any excess compound.
6. Tighten the cable nut while holding the cable firmly in place. Re-tighten after calibration as some loosening may take place after the housing has been heated and cooled. With cable nut properly tightened, secure with 10-32 x 1/4" locking screw.

INTERFACE BOARD SETTINGS & CONNECTIONS

The generator's Interface Board A9 provides the means for electrically connecting external system components, such as collimators, tube stands, buckies, etc., and verifying the correct Rotor Boost Voltage setting (non-high speed starter systems only). Figure 2-15 shows connection locations on a typical non-digital (film-based) system Interface Board; Figure 2-16 shows connection locations on a typical digital imaging system Interface Board.

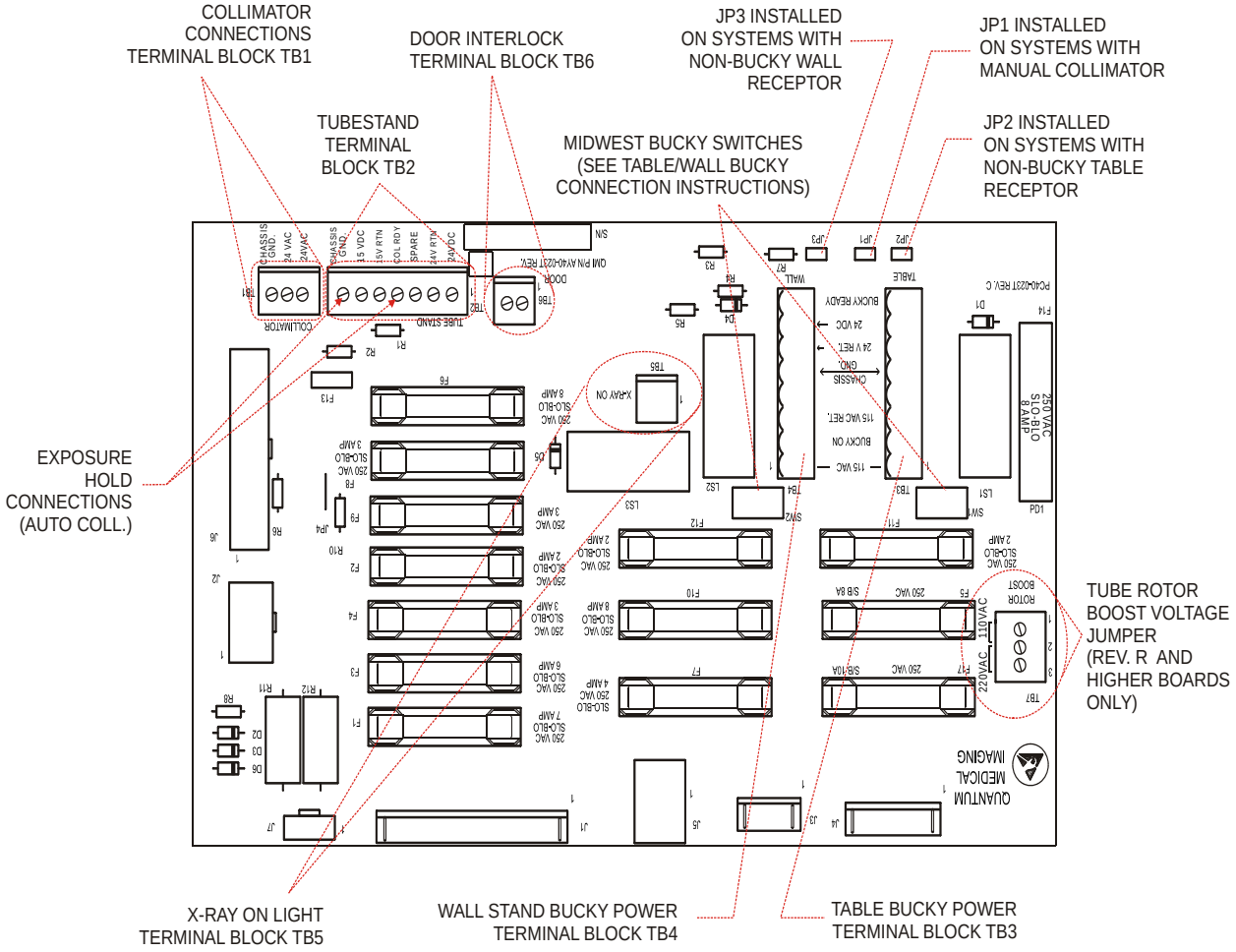

COLLIMATOR CONNECTIONS TERMINAL BLOCK TB1
DOOR INTERLOCK TERMINAL BLOCK TB6
JP3 INSTALLED ON SYSTEMS WITH NON-BUCKY WALL RECEPTOR
JP1 INSTALLED ON SYSTEMS WITH MANUAL COLLIMATOR
TUBESTAND TERMINAL BLOCK TB2
MIDWEST BUCKY SWITCHES (SEE TABLE/WALL BUCKY CONNECTION INSTRUCTIONS)
JP2 INSTALLED ON SYSTEMS WITH NON-BUCKY TABLE RECEPTOR
EXPOSURE HOLD CONNECTIONS (AUTO COLL.)
TUBE ROTOR BOOST VOLTAGE JUMPER (REV. R AND HIGHER BOARDS ONLY)
X-RAY ON LIGHT TERMINAL BLOCK TB5
WALL STAND BUCKY POWER TERMINAL BLOCK TB4
TABLE BUCKY POWER TERMINAL BLOCK TB3

Figure 2-15. Non-Digital System Interface Board A9 - Connection Locations

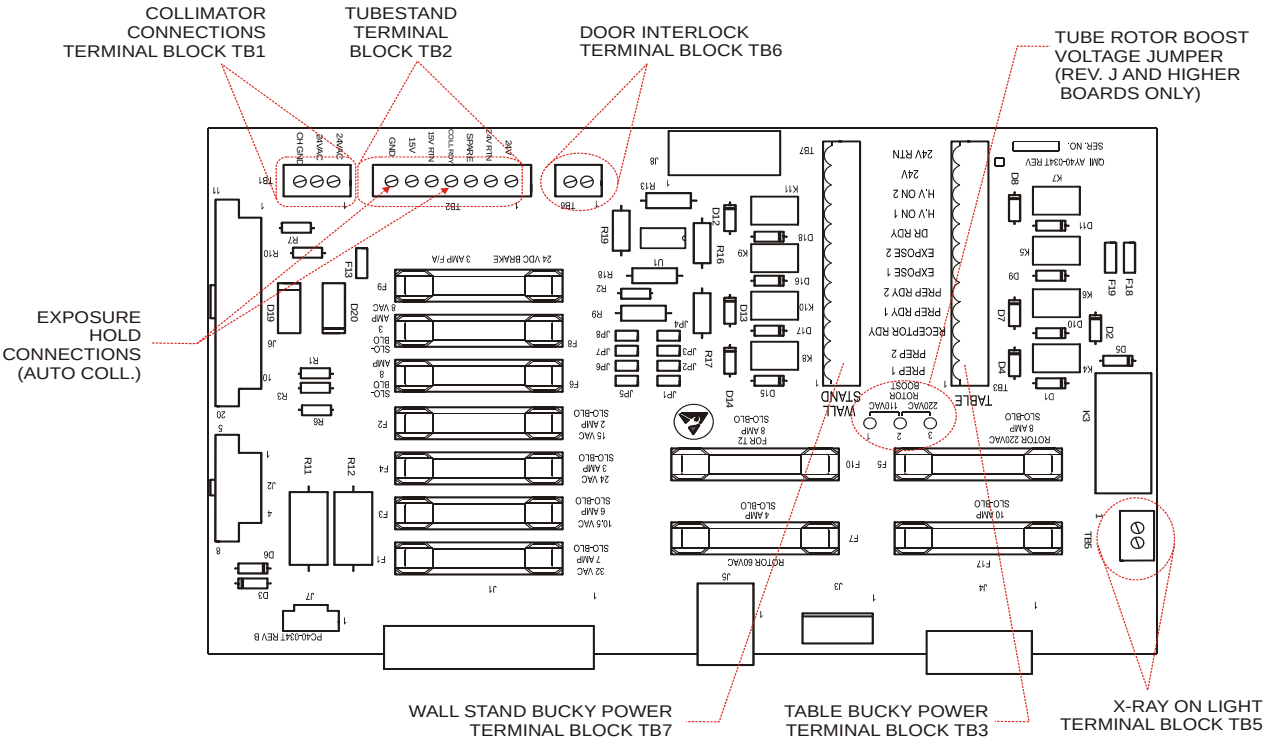

COLLIMATOR CONNECTIONS TERMINAL BLOCK TB1
TUBESTAND TERMINAL BLOCK TB2
DOOR INTERLOCK TERMINAL BLOCK TB6
TUBE ROTOR BOOST VOLTAGE JUMPER (REV. J AND HIGHER BOARDS ONLY)
EXPOSURE HOLD CONNECTIONS (AUTO COLL.)
WALL STAND BUCKY POWER TERMINAL BLOCK TB7
TABLE BUCKY POWER TERMINAL BLOCK TB3
X-RAY ON LIGHT TERMINAL BLOCK TB5

Figure 2-16. Digital System Interface Board A9 - Connection Locations

Door Interlock Switch Connection

To wire a door interlock circuit, remove jumper and connect door interlock wires (supplied by installer) to terminal block TB6 pins 1 and 2 on Interface Board A9 [(P/N AY40-023T/or AY40-061T on internal high-speed starter systems) or (AY40-034T/or AY40-062T on internal high-speed starter systems)]. See Figures 2-15 or 2-16 for terminal board TB6 location. When the door is closed, the circuit will be continuous (contacts closed).

"In Use" Light Switch Connection

To wire an "X-ray On" or "In-Use light", connect wires from light circuit (supplied by installer) to terminal board TB5 pins 1 and 2 on Interface Board A9 [(P/N AY40-023T/or AY40-061T on internal high-speed starter systems) or (AY40-034T/or AY40-062T on internal high-speed starter systems)] (On AY40-062T boards, pin 3 is not used). See Figures 2-15 or 2-16 for terminal block TB5 location. When the X-ray generator is in either PREP or EXPOSE states, the circuit will be continuous (contacts closed).

Collimator Connections

Terminal block TB1 (see Figures 2-15 or 2-16 for terminal block TB1 location) provides 24 VAC (TB1-1 and TB1-2) and chassis ground (TB1-3) outputs for connection to a collimator. On systems equipped with a manual collimator, verify jumper A9JP1 is installed; remove A9JP1 if system is equipped with an automatic collimator.

Also available on terminal block TB2 is the COL RDY terminal (at TB2-4) for connection to automatic collimator with "exposure hold" interlock (use CHASSIS GND terminal TB2-7 for return). Refer to collimator manual for specific connection details.

Tube Stand/Peripheral Equipment Connections

Interface Board A9 Terminal block TB2 (see Figures 2-15 or 2-16 for terminal board TB2 location) provides +28 VDC (TB2-1) and +28 VDC RTN (TB2-2) terminals for connection of a tube stand power input cable, when applicable. Maximum load current is 1.5A at these terminals.

Internal +28 VDC Power Supply Option (QG-28VPS)

If generator is equipped with +28 VDC Internal Power Supply Option (QG-28VPS), see Figure 2-16a and connect the tubestand/wallstand's power supply input leads as follows:

1. Positive lead to terminal P2-1 (+) on power supply
2. Negative lead to terminal P2-2 (-) on power supply

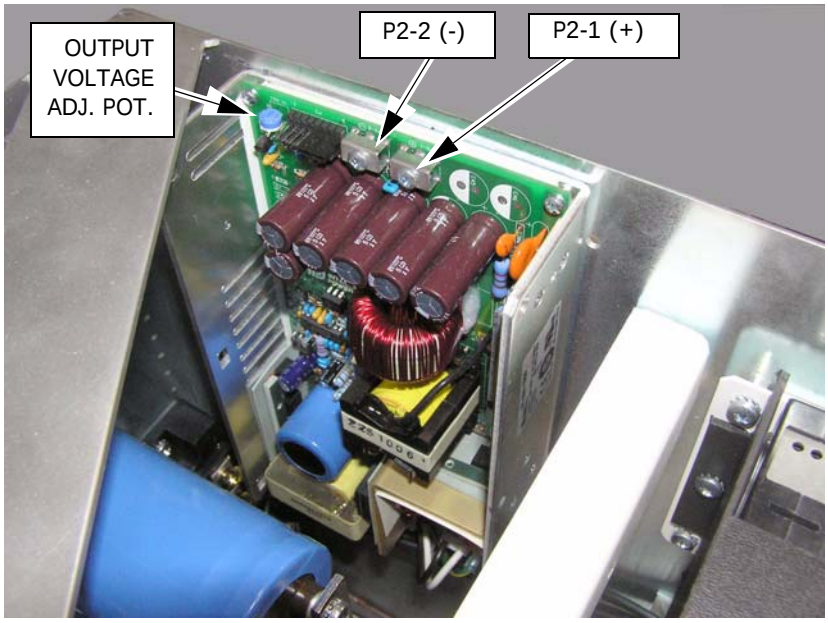


Figure 2-16a. Internal +28 VDC Power Supply Option (QG-28VPS) Location

The output of the +28 VDC Power Supply is adjusted depending on the type of Quantum product it will supply power to, as indicated below:

Table 2-1a: Internal +28 VDC Power Supply Option (QG-28VPS) Adjustment

Quantum Product Type	Adjust Power Supply Output To:
Model RS-580 Overhead Tube Crane	+30 VDC
Model QV-800 Universal System	+28 VDC
Model QW-420-T, QW-420-T-D Vertical Tilting Wall Stand	+28 VDC

When using the +28 VDC Power Supply Option to provide power for a Model RS-580 Overhead Tube Crane, the +30 VDC output is intended for operating the tube crane's transverse and longitudinal electromagnetic locks (brakes). Refer to the RS-580 Service Manual for connection instructions.

CAUTION! The Internal +28 VDC Power Supply Option (QG-28VPS) is only available with 3-phase generators, and is intended to supply power to a single, external device.

Tube Rotor Boost Voltage Verification (Systems without High (Dual) Speed Starter Option)

Ensure Interface Board A9 [P/N AY40-023T (non-digital systems, revision R or later boards only)/AY40-023T1 (non-digital stored energy systems, revision K or later boards only)/AY40-034T (digital systems, revision J or later boards only)] Tube Rotor Boost Voltage Jumper is configured correctly depending on the type of tube the generator is being interfaced with according to table below:

Table 2-1: Tube Rotor Boost Voltage Jumper Setting

TUBE TYPE	JUMPER POSITION	ROTOR BOOST VOLTAGE SETTING
Toshiba E7252X, E7813X, E7242X, E7239X	Pins 1-2	100 VAC Stator
All others (220 VAC stator)	Pins 2-3	220 VAC Stator

RADIOGRAPHIC SYSTEM EQUIPMENT CONNECTIONS

The following paragraphs provide instructions for cable connections between the HF Series x-ray generator and the x-ray tube, table, and wall bucky, as necessary. Refer to Generator Interconnection Diagrams in Chapter 6, DIAGRAMS for additional guidance.

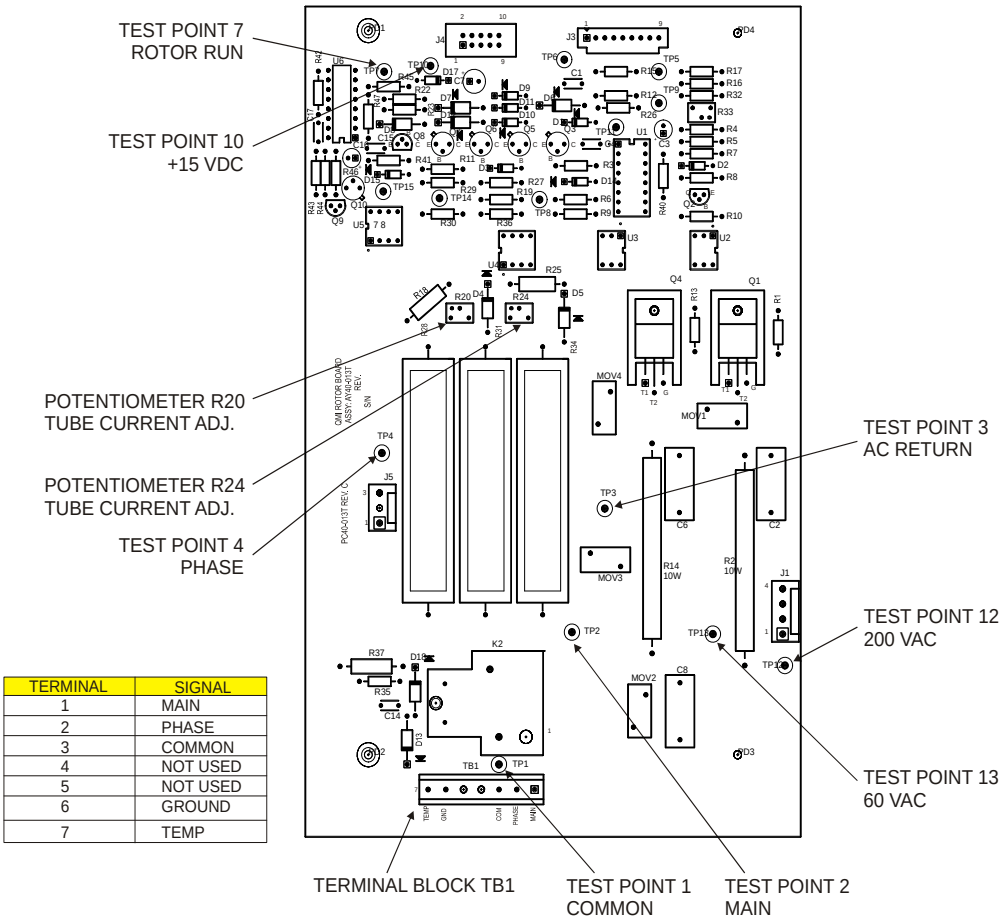
Ensure the generator is configured with the correct value rotor phase capacitor C1 (on the Generator door) for tube installed in the system (refer to Table 2-2).

Table 2-2: Standard Single-Speed Rotor Phase Capacitor Configuration

Tube Type	Rotor Phase Capacitors
E7239X, E7242X	25 uF
E7254X, E7255X, ALL VARIAN, ALL DUNLEE (including MX100 Replacement for GE Radiographic System)	30 uF
E7813X, E7252X	45 uF

Tube Rotor Cable (Systems without High (Dual) Speed Starter Option)

Route the X-ray Tube Rotor Cable AY51-014 through the middle cable access opening located in the top rear wall of the generator chassis. Connect one end of the cable to the appropriate terminals on Terminal Block TB1 on Rotor Drive Board A10 (P/N AY40-013T) as shown in Figure 2-17. Connect the opposite end to the X-ray tube's terminal strip (refer to appropriate interconnection diagram in Chapter 6, DIAGRAMS for tube connections).



TERMINAL	SIGNAL
1	MAIN
2	PHASE
3	COMMON
4	NOT USED
5	NOT USED
6	GROUND
7	TEMP

Figure 2-17. Rotor Board AY40-013T Tube Rotor Cable Connections

Tube Rotor Cable (Systems with AID External High Speed Starter QG-HSS Option Only)

Refer to Figure 2-18, the AID High Speed Starter installation manual and/or the appropriate interconnection diagram in Chapter 6, DIAGRAMS for high speed starter connections. ***Note: This procedure applies only to systems equipped with the externally-connected AID High Speed Starter option.***

1. Connect one end of X-ray Tube Rotor Cable AY51-032T to the appropriate connector/terminals on AID High Speed Starter LC102 terminal block TS2 (see Figure 2-18).
2. Connect the opposite end to the X-ray tube's terminal strip.
3. Route the X-ray Tube Rotor Cable AY51-033 (Toshiba tubes) through the middle cable access opening located in the top rear wall of the generator chassis.
4. Connect one end of the High Speed Starter Cable AY51-033 to the appropriate connector/terminals on AID High Speed Starter terminal strips TB1 and TB2 and connect to Cable Assembly AY51-032T (temperature sense connector).
5. Connect the opposite end of the High Speed Starter Cable AY51-033 to connector J8 on Logic Board A1, AY40-006S.
6. Connect 220 VAC power input to High Speed Starter.
7. The AID High Speed Starter was factory pre-configured for the x-ray tube supplied with the generator. Verify boost and brake settings are correct according tube manufacturer's data sheets (refer to Table 2-3). Verify the high speed starter is configured with the correct capacitors for the tube used with the system: Toshiba E7252X and E7813X should be configured for 45 uF. All other tube types require 30 uF.

Table 2-3: AID High Speed Starter DIP Switch Settings

TUBE TYPE	START VOLTAGE (180 HZ)	RUN VOLTAGE (180 HZ)	HSS SWITCH SW1 (BOOST TIME)	HSS SWITCH SW2 (BRAKE TIME)
TOSHIBA E7813X, E7252X	220 VAC (#6 tap*)	60 VAC (75 VAC #3 tap*)	1.2 seconds: SW1-1 = OFF SW1-2 = ON SW1-3 = ON SW1-4 = OFF SW1-5 = OFF	2.0 seconds: SW2-1 = OFF SW2-2 = ON SW2-3 = OFF SW2-4 = ON SW2-5 = OFF
TOSHIBA E7254X, E7255X	490 VAC (use 370 VAC tap #10*)	165 VAC (75 VAC #3 tap*)	2.0 seconds: SW1-1 = OFF SW1-2 = ON SW1-3 = OFF SW1-4 = ON SW1-5 = OFF	2.0 seconds: SW2-1 = OFF SW2-2 = ON SW2-3 = OFF SW2-4 = ON SW2-5 = OFF
VARIAN (ALL 3 INCH DIA.)	320 VAC (use 370 VAC tap #10*)	100 VAC (75 VAC #3 tap*)	1.0 seconds SW1-1 = ON SW1-2 = OFF SW1-3 = ON SW1-4 = OFF SW1-5 = OFF	2.0 seconds: SW2-1 = OFF SW2-2 = ON SW2-3 = OFF SW2-4 = ON SW2-5 = OFF
VARIAN (ALL 4 INCH DIA.)	450 VAC (use 370 VAC tap #10*)	100 VAC (75 VAC #3 tap*)	2.2 seconds SW1-1 = ON SW1-2 = ON SW1-3 = OFF SW1-4 = ON SW1-5 = OFF	2.0 seconds: SW2-1 = OFF SW2-2 = ON SW2-3 = OFF SW2-4 = ON SW2-5 = OFF

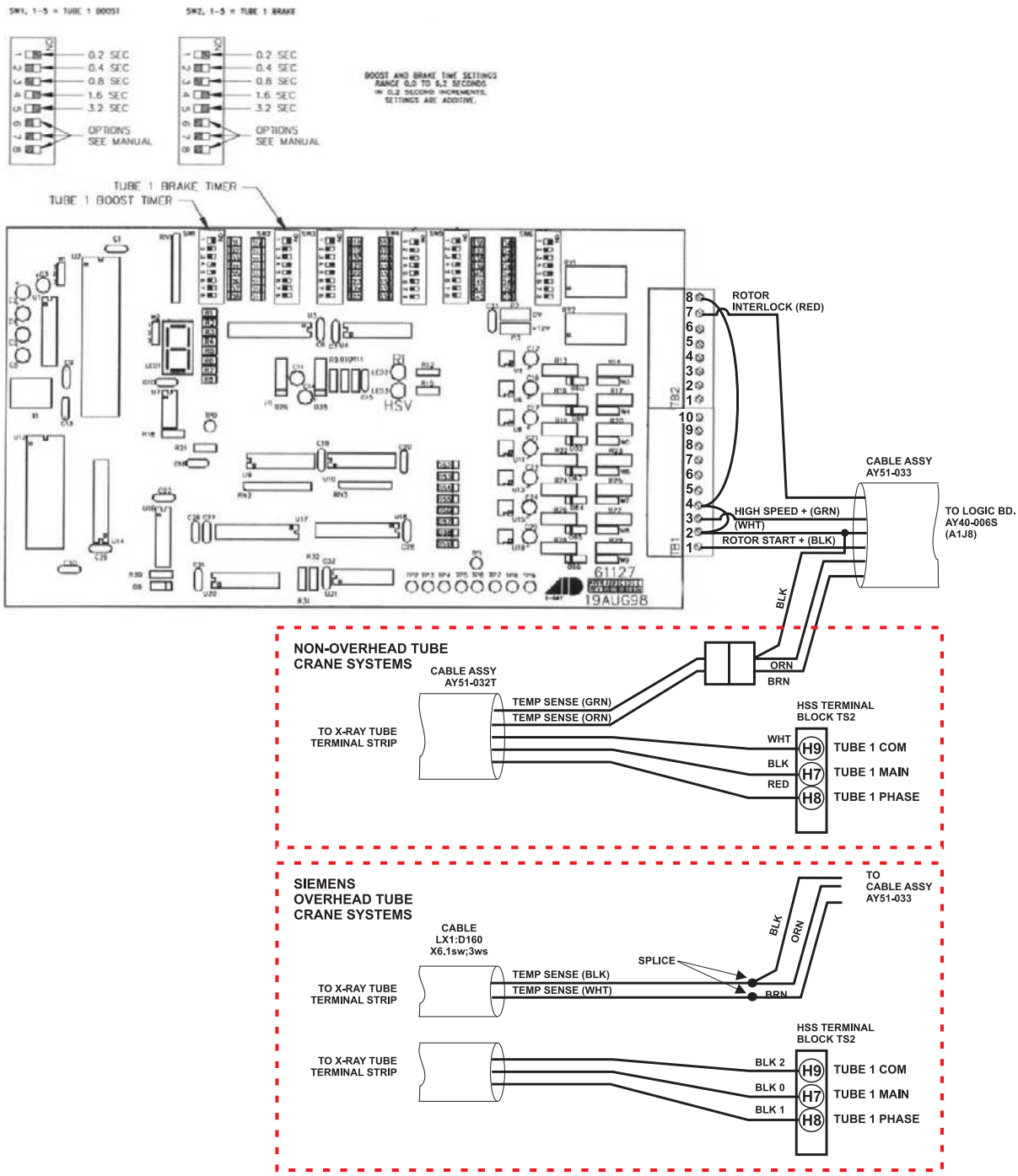


Figure 2-18. AID High Speed Starter Connections

Tube Rotor Cable (Systems with Internal High Speed Starter Q-HSS Option Only)

The Q-HSS High Speed Starter is factory pre-configured for the x-ray tube supplied with the generator and, with the exception of the Rotor Cable, does not require any field connections or adjustments. Tables 2-3a and 2-3b are provided in the event tube replacement is necessary or if the HSS Power Driver Board AY40-036S needs replacement. The table indicates the proper connections of the various transformer voltage inputs (380, 220, 120, 80, 60 and 0 VAC) to the HSS Driver Board at Terminal Block TB1 for each of the compatible tubes used with the generator.

Also, ensure the generator is configured with the correct value rotor capacitors for the installed tube as indicated in Table 2-3a.

Table 2-3a: Quantum High-Speed Starter Rotor Phase Capacitor Configuration

Tube Type	Rotor Phase Capacitors
E7813X, E7252X, E7869X	Install one (1) 40 uF cap (low speed), two (2) 12 uF in series (high speed)
E7254X, all Varian, all Dunlee (except MX100 GE replacement, see below)	Install one (1) 25 uF cap (low speed), two (2) 12 uF in series (high speed)
Dunlee MX100 Replacement for GE Radiographic System	Install one (1) 25 uF cap (low speed), two (2) 15 uF in series (high speed)

If not already connected, connect transformer input wires to HSS Driver Board AY40-036S terminal block TB1 plug for correct tube type in accordance with table below:

Table 2-3b: HSS Driver Board AY40-036S Boost and Run Voltage Requirements: Transformer Input Wires to Terminal Block Plug TB1

	TB1-1	TB1-3	TB1-5	TB1-6	TB1-7
TUBE MODEL	HIGH SPEED BOOST VOLTAGE	LOW SPEED BOOST VOLTAGE	HIGH SPEED RUN VOLTAGE	LOW SPEED RUN VOLTAGE	COMMON
TOSHIBA E7255, E7254	WIRE #5 (380 VAC)	WIRE #4 (220 VAC)	WIRE #3 (120 VAC)	WIRE #2A (80 VAC)	WIRE #1 (0 VAC)
TOSHIBA E7252, E7813	WIRE #4 (220 VAC)	WIRE #3 (120 VAC)	WIRE #2A (80 VAC)	WIRE #2 (60 VAC)	WIRE #1 (0 VAC)

Table 2-3b: HSS Driver Board AY40-036S Boost and Run Voltage Requirements: Transformer Input Wires to Terminal Block Plug TB1

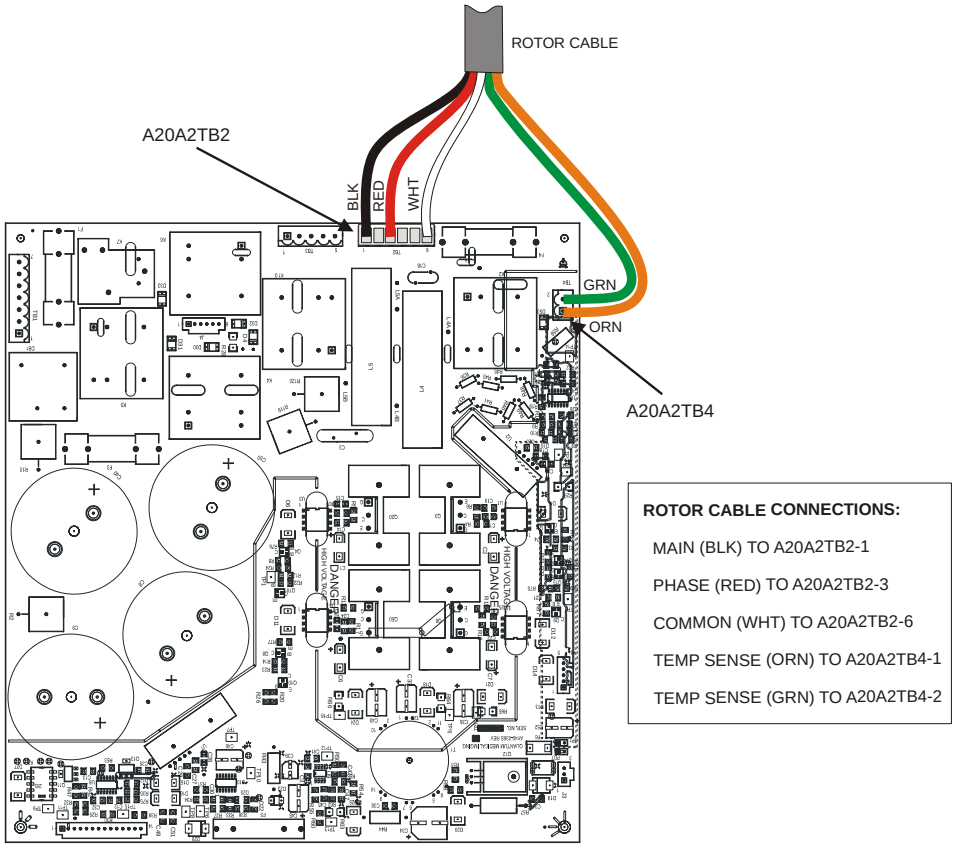
	TB1-1	TB1-3	TB1-5	TB1-6	TB1-7
TUBE MODEL	HIGH SPEED BOOST VOLTAGE	LOW SPEED BOOST VOLTAGE	HIGH SPEED RUN VOLTAGE	LOW SPEED RUN VOLTAGE	COMMON
VARIAN RAD 92, RAD 60, RAD 56, RAD 44, A292, A272; DUNLEE DA 1092, DU309, PX 1302, PX 1312, PX 1429, PX 1436	WIRE #5 (380 VAC)	WIRE #4 (220 VAC)	WIRE #3 (120 VAC)	WIRE #2 (60 VAC)	WIRE #1 (0 VAC)
VARIAN RAD 21, RAD 14, RAD 13, A192; TOSHIBA E7869X DUNLEE MX100 Replacement for GE	WIRE #5 (380 VAC)	WIRE #4 (220 VAC)	WIRE #2A (80 VAC)	WIRE #2 (60 VAC)	WIRE #1 (0 VAC)
NOTE 1: Stow unused WIRE #2 (60 VAC) or WIRE #2A (80 VAC) in unused terminal block TB1-2 location. ***NOTE 2: Terminal block location TB1-4 is not used.***					

Non-Overhead Tube Crane Rotor Cable Wiring Instructions

Refer to Figure 2-18a and the steps below to connect the Rotor Cable to the HSS Driver Board x-ray tube on a system ***not using*** an Overhead Tube Crane.

1. Route the X-ray Tube Rotor Cable from the tube through the middle cable access opening located in the top rear wall of the generator chassis.
2. Connect the MAIN (BLK) conductor to terminal 1 on HSS Driver Board A20A2 Terminal Block TB2.
3. Connect the PHASE (RED) conductor to terminal 3 on HSS Driver Board A20A2 Terminal Block TB2.
4. Connect the COMMON (WHT) conductor to terminal 6 on HSS Driver Board A20A2 Terminal Block TB2.
5. Connect the TEMP SENSE (ORN) conductor to terminal 1 on HSS Driver Board A20A2 Terminal Block TB4.
6. Connect the TEMP SENSE (GRN) conductor to terminal 2 on HSS Driver Board A20A2 Terminal Block TB4.

7. Connect the opposite end to the X-ray tube's terminal strip.



HSS DRIVER BOARD A20A2 (AY40-036S)

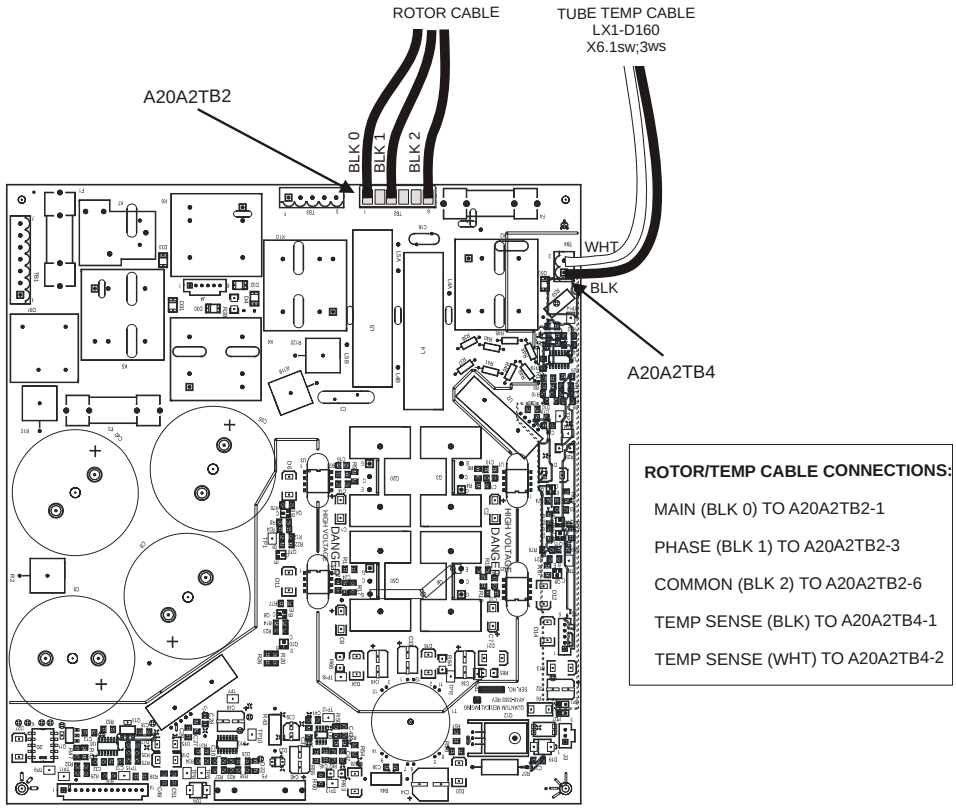
Figure 2-18a. Non-Overhead Tube Crane System Rotor Cable Connections

Overhead Rotor Cable Wiring Instructions

Refer to Figure 2-18b and the steps below to connect the Rotor Cable to the x-ray tube on a system **using** an Overhead Tube Cranes:

1. Route the X-ray Tube Rotor Cable from the tube through the middle cable access opening located in the top rear wall of the generator chassis.
2. Connect the MAIN (BLK 0) conductor to terminal 1 on HSS Driver Board A20A2 Terminal Block TB2.
3. Connect the PHASE (BLK 1) conductor to terminal 3 on HSS Driver Board A20A2 Terminal Block TB2.
4. Connect the COMMON (BLK 2) conductor to terminal 6 on HSS Driver Board A20A2 Terminal Block TB2.

5. Connect the TEMP SENSE (BLK) conductor to terminal 1 on HSS Driver Board A20A2 Terminal Block TB4.
6. Connect the TEMP SENSE (WHT) conductor to terminal 2 on HSS Driver Board A20A2 Terminal Block TB4.
7. Connect the opposite end to the X-ray tube's terminal strip.



HSS DRIVER BOARD A20A2 (AY40-036S)

Figure 2-18b. Overhead Tube Crane System Rotor Cable Connections

Table / Wall Bucky Connections

Wall stand and/or table buckies are interconnected to the HF Series x-ray generator via Interface Board A9, P/N AY40-023T terminal blocks A9TB4 (Wall Stand) and A9TB3 (Table) or Digital Interface Board AY40-034T terminal blocks A9TB7 (Wall Stand) and A9TB3 (Table) using 5-conductor, 18AWG cable (P/N EL75-025), which is provided with the table and/or wall stand.

IMPORTANT! When interfacing to a 14" x 17" Midwest table or wall bucky, switches A9SW1 or A9SW2, respectively, must be set to the "M" position. For 14" x 36" Midwest, Progeny, or LF type buckies, switches A9SW1 or A9SW2 must not be set to the "M" position.

Refer to bucky manufacturer's installation manual (provided with system) for specific bucky wiring information and to Figures 2-15, 2-16, and in Chapter 6, DIAGRAMS, Figures 6-6 through 6-9. Bucky cable entrance/exit is provided through the access opening in the top rear panel of the generator chassis. DO NOT route cables through an opening containing a High Voltage Cable (see Figure 2-13). When connecting a table bucky, remove jumper JP2 on Interface Board A9. When connecting a wall bucky, remove jumper JP3 on Interface Board A9.

Table / Wall Ion Chamber Connections (AEC Option Only)

Systems equipped with standard type AEC (AEC Board AY40-031S):

If using a wall ion chamber, connect wall ion chamber cable to AEC Board A11, P/N AY40-031S connector J2. If using a table ion chamber, connect table ion chamber cable to AEC Board A11 connector J4. Table 2-4 shows AID type ion chamber connector pin assignments. Route the ion chamber cable(s) as necessary to exit through the access opening in top rear side of generator chassis, and secure as required. DO NOT route through an opening containing a High Voltage Cable (see Figure 2-13).

Table 2-4: AID ICX-153 or ICX-1153 Ion Chamber 9-Pin Sub-D Connector Pin-Outs

9-PIN SUB-D CONNECTOR PIN	FUNCTION
1	NONE
2	FIELD 2 SELECT
3	FIELD 1 SELECT
4	RESET
5	OUTPUT
6	FIELD 3 SELECT
7	NEGATIVE SUPPLY
8	POSITIVE SUPPLY
9	GROUND

(Note: Perform ion chamber balance procedure in accordance with manufacturer's instructions provided with chamber.)

Typically, when the HF Series x-ray generator is shipped with an AID ICX ion chamber, the chamber jumpers are pre-set in the following configuration:

Table 2-5: AID ICX-153 or ICX-1153 Ion Chamber Jumper Configuration

JUMPER	POSITION	FUNCTION
61135A W1	1-2 & 3-4	LOW ACTIVE RESET
61135A W2, W3, W4	1-2 & 3-4	LOW ACTIVE FIELD SELECT
61135A W5, W6	1-2 & 3-4	A-B-C = 2-1-3
61135A W7	2-3	POSITIVE OUTPUT SIGNAL

CAUTION! The ion chamber must be electrically isolated from the bucky to ensure proper AEC system performance.

For systems equipped with universal type AEC (AEC Board AY40-027S):

Up to four ion chambers can be used. Connect ion chambers as follows:

- Wall#1 ion chamber to A11J8
- Wall#2 ion chamber to A11J12
- Table ion chamber to A11J10
- Auxiliary ion chamber to A11J13

Note that to connect a Siemens ion chamber AEC cable to universal AEC Board A11 requires an interface cable assembly AY51-061 for each chamber. This cable assembly adapts the ion chamber connector to 9-pin D-Sub type used on the AEC Board, and provides a separate 300 VDC wire for connection to A11TB1.

Route the ion chamber cable(s) as necessary to exit through the access opening in top rear side of generator chassis, and secure as required. DO NOT route through an opening containing a High Voltage Cable (see Figure 2-13).

Interfacing to Canon Digital Radiographic Receptor (When Applicable)

The digital radiographic receptor is interconnected to the HF Series x-ray generator via Interface Board A9, P/N AY40-034T terminal blocks A9TB7 (Wall Stand) and A9TB3 (Table), respectively, using 4-conductor, 18AWG cable. Refer to the digital receptor manufacturer's installation manual for more detailed wiring instructions.

Digital receptor cable entrance/exit is provided through the access opening in the top rear panel of the generator chassis. DO NOT route signal cables through an opening containing a High Voltage Cable (see Figure 2-13). When connecting to a table digital receptor, remove jumper JP2 on Interface Board A9. When connecting to wall digital receptor, remove jumper JP3 on Interface Board A9.

Interfacing to CMT Digital Radiographic Receptor (When Applicable)

Refer to CMT digital receptor installation manual for detailed wiring instructions.

Interfacing to Siemens Ion Chambers (When Applicable)

Note: When interfacing the generator to a Siemens table/wall ion chamber and a Quantum table/wall ion chamber (AID type), only the Siemens ion chambers require the use of cable assembly AY51-061. The Quantum table/wall ion chamber can be connected directly to AEC Board A11 (AY40-027S) connector J10 (TABLE) or J8 (WALL).

Interfacing of the HF Series x-ray generator to Siemens table and/or wall ion chambers, such as in Siemens Tomography System, is facilitated using the "universal" type AEC Board A11 (AY40-027S) located on the front side of the generator cabinet PCB door. The VERTIX wall stand and MULTIX table ion chambers are connected as shown in Figure 2-19. Note that cable assemblies AY51-061 shown in the illustration should already be connected to both the MULTIX table AEC cable EK14 and the VERTIX wall stand AEC cable. Any additional ion chambers used with the system are connected as described in "Table/Wall Ion Chamber Connections (AEC Option Only)" procedure included in this chapter.

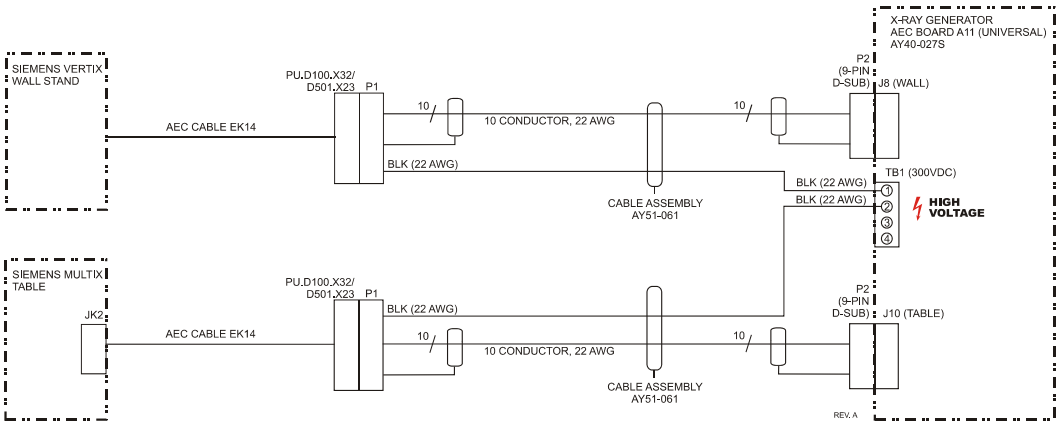


Figure 2-19. AEC Ion Chamber Connections (Siemens Tomography System)

Secure the ion chamber cables to the PCB Door using cable ties as shown in Figure 2-20.

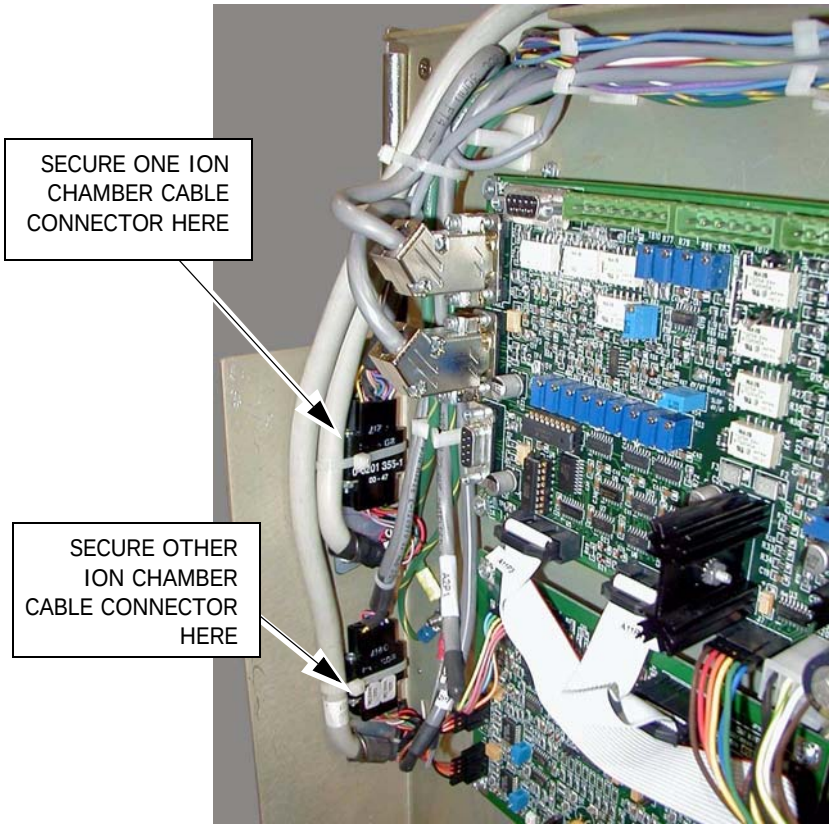


Figure 2-20. Siemens Ion Chamber Cable Management

Interfacing to Siemens Tomography System (When Applicable)

The Siemens tomo interface cable (supplied with the Siemens system) has attached to it at one end three plugs identified as "KK1B G1,G2 X10", "KK1B G1,G2 X11" and "KK1B G1,G2 X12". Plugs "X10" (TABLE), "X11" (WALL) and "X12" (TOMO SWEEP TIME) will need to be cut off and the wire ends stripped to allow connection to the universal AEC Board A11 (AY40-027S) pluggable

terminal blocks A11TB10, A11TB12 and A11TB11, respectively. Refer to Figure 2-21 for Siemens tomo interface cable wire connections. Secure the tomo interface cable securely using cable ties.

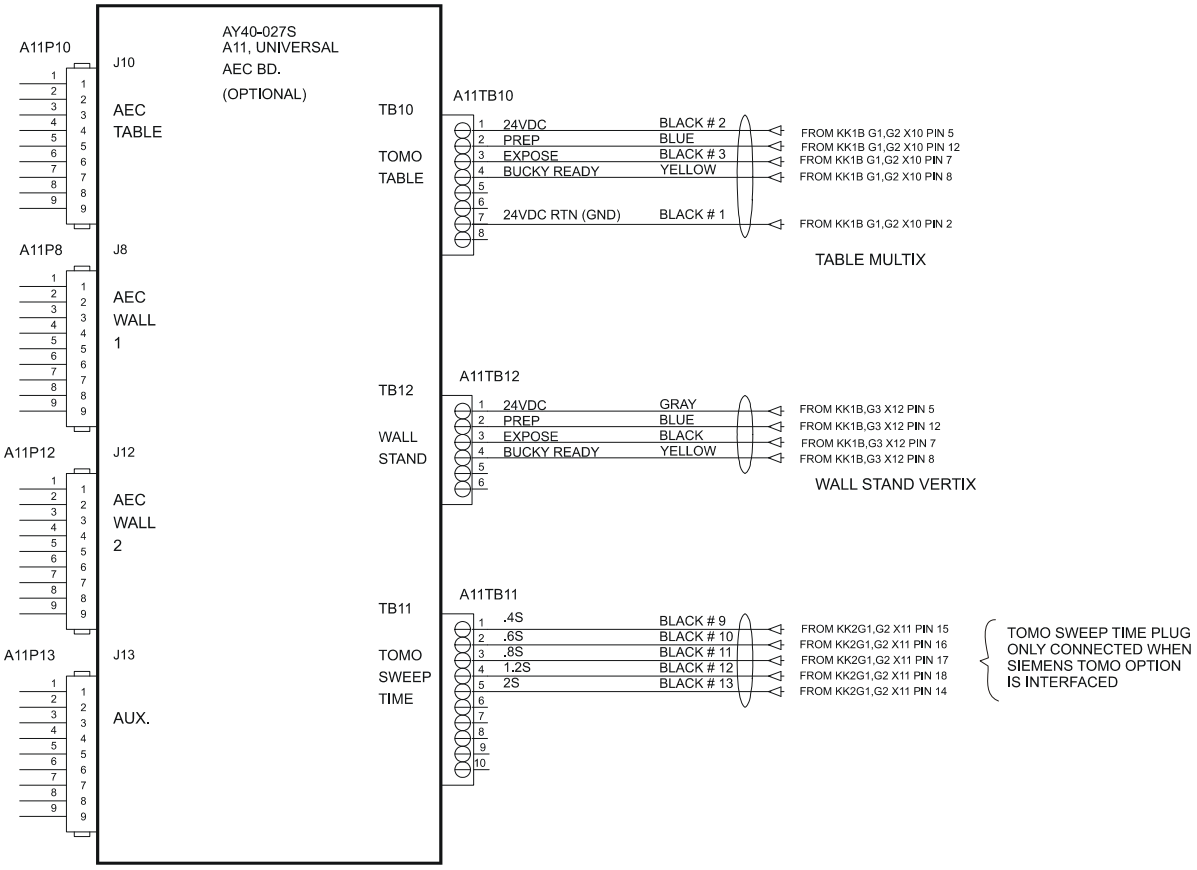


Figure 2-21. Siemens Tomo/Ion Chamber Interface Cable Interconnection Diagram

Check that jumper JP1 is installed on Universal AEC Board A11 (AY40-027S). If not, install a jumper.

Interfacing to Pausch Tomography System (When Applicable)

To interface the HF Series generator to Pausch tomo system, two lengths of 10-conductor shielded cable is required (supplied with the HF Series generator). No wire terminations are required for interconnecting the cables. Refer to Figure 2-22 for Pausch tomo/generator interface wiring. After interfacing, secure the tomo interface cable securely using cable ties as required.

Check that jumper JP1 is not installed on Universal AEC Board A11 (AY40-027S). If installed, remove this jumper.

IMPORTANT! Be sure to re-program the tomo sweep times on the Pausch tomography system to correspond with available time settings selectable at the HF Series generator Operator Control Panel.

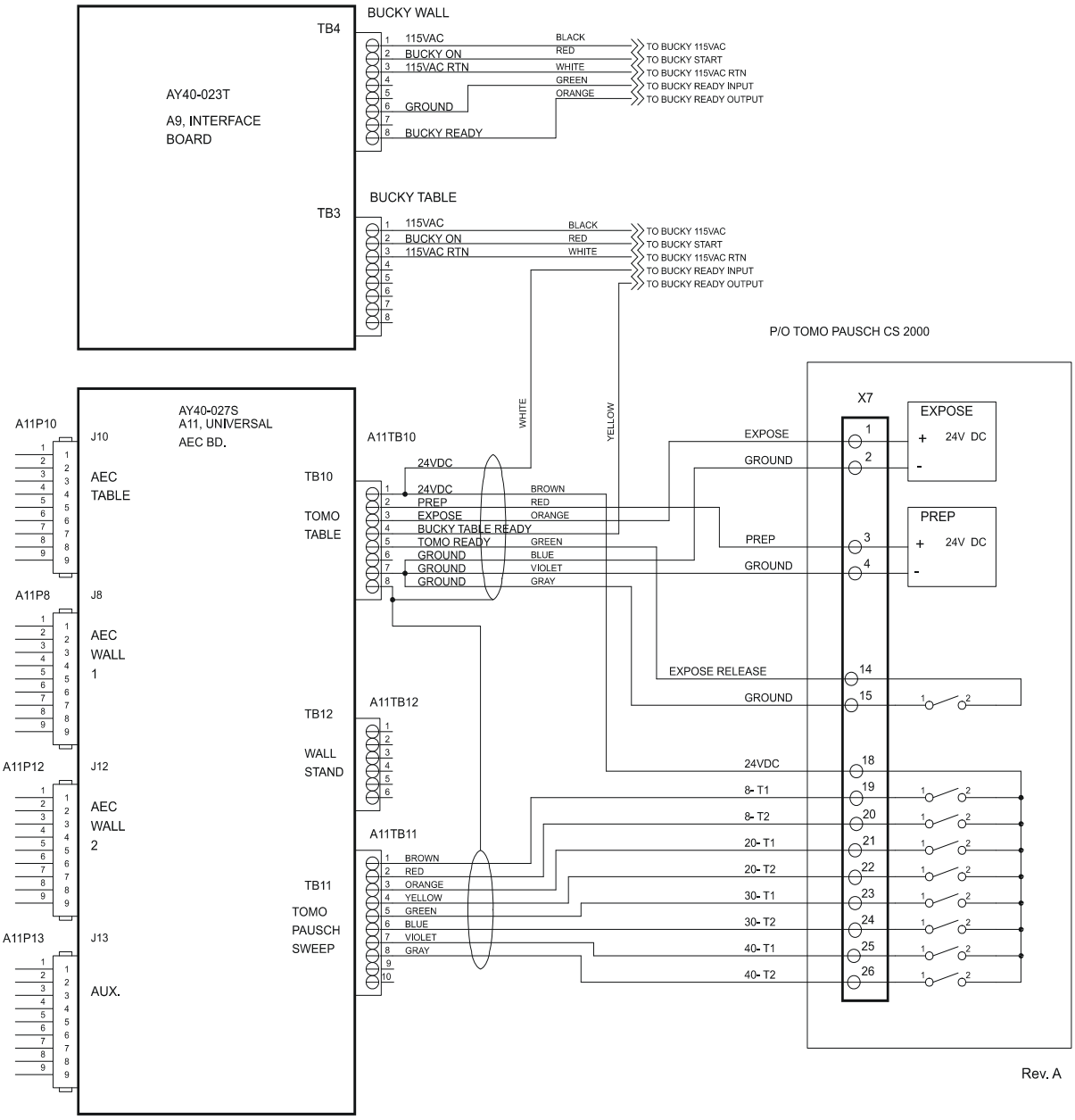


Figure 2-22. Pausch Tomography System Interconnection Diagram

OPERATOR CONTROL PANEL SETUP

The HF Series X-ray Generator is available with several different types of operator control panel (OCP) configurations. These include:

- ODYSSEY Operator Control Panel
- Q-VISION Touch-Screen Operator Control Panel
- Integrated Workstation Control Panel (e.g., Canon DR Workstation, Agfa NX Workstation, etc.)

The paragraphs that follow describe the installation and setup procedures for each type control panel.

ODYSSEY Operator Control Panel

The ODYSSEY Operator Control Panel (OCP) is provided with a 50-ft. interconnect cable. Extended length OCP cables are available; part number QG-CBL65 is 65-ft. length, and part number QG-CBL85 is 85-ft. length. The OCP can be placed directly on a shelf, table top, or on top of the Generator Cabinet, resting on its rubber-tipped feet. It may also be mounted on a pedestal (requires QG-PDL option) or on a wall-mounted bracket (requires QG-WM option). The following are installation instructions for each option.

OCP Pedestal Mounting (QG-PDL Option)

1. On systems equipped with Pedestal Mount option QG-PDL, mount the OCP on the pedestal as follows:
   Turn the OCP over and rest it on a surface covered with soft material.
2. Remove four (4) OCP front panel screws.
3. Turn over the OCP. Lift up OCP front panel to access OCP mounting holes (if necessary, insert a small flat blade screwdriver under the edge of the panel, in the upper left side, and lift up panel).
4. Position the OCP on the pedestal aligning the pedestal mounting holes in the bottom of OCP with the mounting holes in the top flange of the pedestal.
5. Secure the OCP to the pedestal using four (4) 1/4-20 x 3/4" pan head phillips screws, flat washers and nuts.
6. Re-install four (4) OCP front panel screws.

CAUTION! The OCP serial cable shield (yellow/green wire) provides a protective earth ground from the OCP to the generator cabinet. Verify both ends of the OCP serial cable are properly secured to grounded mounting screws as described in the following step.

7. Connect OCP serial cable (P/N AY51-018) between connector A16J1 on the OCP and connector J5 on CPU Board A1 (P/N AY40-006T).

8. Connect the yellow/green ground wires at each end of OCP serial cable to the nearest mounting screw on OCP Control Board A16A1 (AY40-004S) and Logic Board A1 (AY40-006S).
9. Ensure the connector screws and PCB mounting screws are fully tightened.

CAUTION! The OCP serial cable shield is electrically connected to the connector shells at either end of the cable. It is recommended the OCP serial cable connectors not be removed so as not to compromise integrity of cable shield connections. If necessary to remove connector, verify that after the connectors are re-installed, there is less than 0.1 ohm resistance between connector shell at one end of cable and the connector shell at opposite end of the cable.

10. If mounting OCP to floor, either transfer drill four mounting holes in floor using the OCP base plate as a guide or mark the floor in accordance with dimensions given in Figure 2-23, and then drill holes where marked. Drill holes using a #W drill bit (0.390" diameter). After OCP cable connection is complete, secure OCP to floor using 3/8" hardware suitable for floor type.

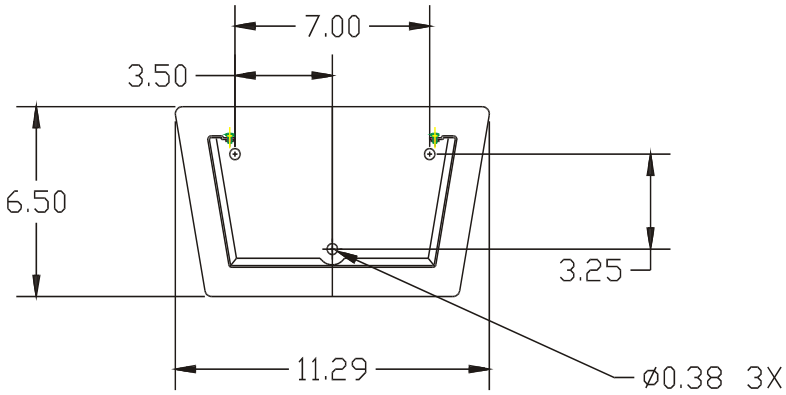


Figure 2-23. OCP Mounting Hole Locations

OCP Wall Mounting (QG-WM Option)

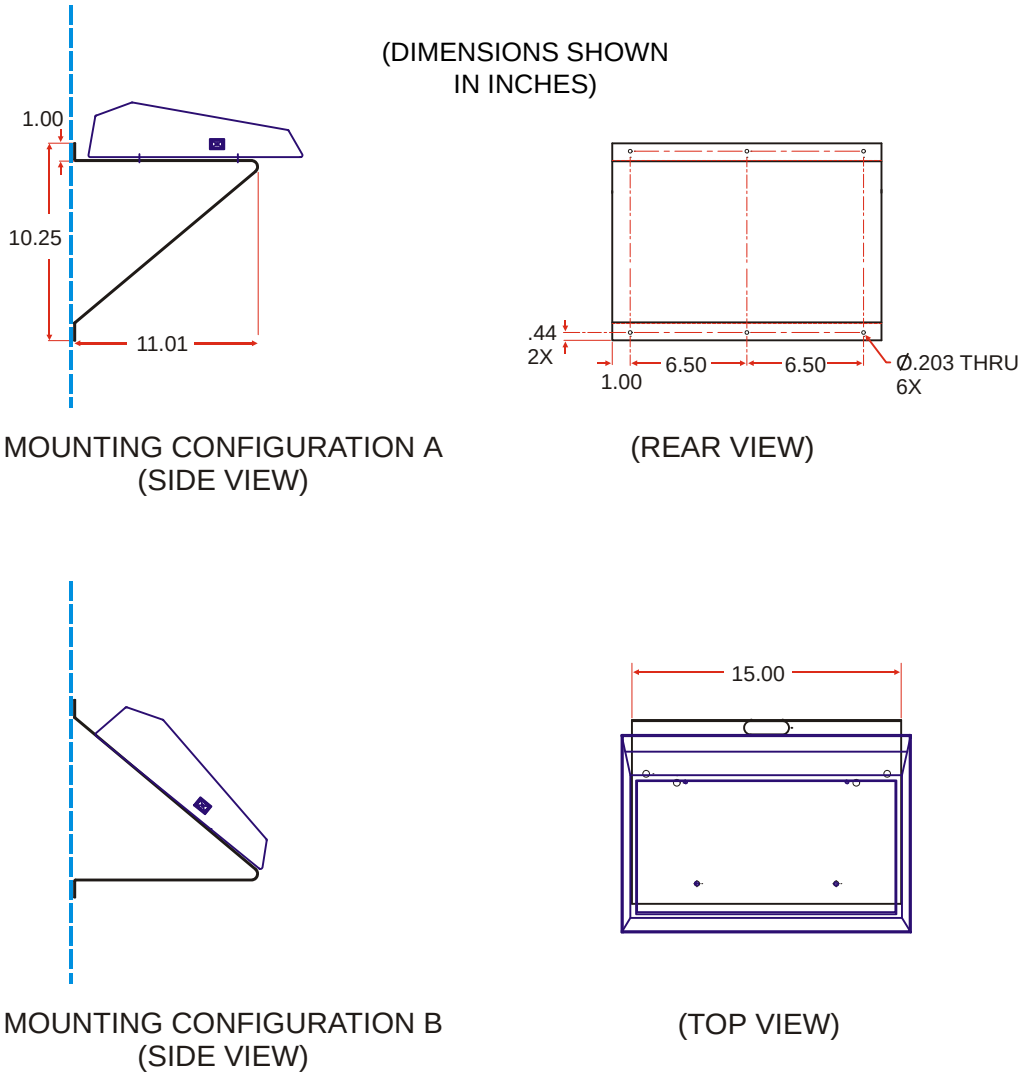


Figure 2-24. QG-WM Wall Mount Option Installation Configurations

On systems equipped with Wall Mounting option QG-WM, mount the OCP to the wall as follows:

1. Secure the Wall Mount to the wall using hardware suitable for wall construction type (each screw capable of supporting 15 lbs. pull load).
2. Turn the OCP over and rest it on a surface covered with soft material.
3. Remove four (4) OCP front panel screws.
4. Turn over the OCP. Lift up OCP front panel (if necessary, insert a small flat blade screwdriver under the edge of the panel, in the upper left side, and lift up panel) to access OCP mounting holes.

5. Position the OCP on the Wall Mount bracket aligning the mounting holes in the bottom of OCP with the mounting holes in the wall bracket.
6. Secure the OCP to the Wall Mount Bracket using four (4) 1/4-20 x 3/4" pan head phillips screws, flat washers and nuts.
7. Re-install four (4) OCP front panel screws.
8. Connect one end of the OCP serial cable (P/N AY51-018) to connector J3 on the OCP. Route the OCP serial cable through the access opening in the Wall Mount Bracket and connect to connector J5 on CPU Board A1 (P/N AY40-006T). Ensure the connector screws are fully tightened. **DO NOT** route serial cable through an opening containing a High Voltage Cable (see Figure 2-13).

Q-VISION Operator Control Panel

The Q-VISION Operator Control Panel (OCP) is an all-in-one PC, with the computer integrated with the touch-screen monitor in a single case. The Q-VISION OCP is provided with a Power/Expose Control Box (AY20-271), which contains a two-stage, hand-held PREP/EXPOSE switch and a built-in generator ON/STANDBY rocker switch for remotely powering on/off the Generator. Cables for interconnection of the Q-VISION OCP and Power/Expose Control Box to the generator are available in either 50-ft. or a 100-ft. interconnect lengths, as specified at the time of order. In order to interface Q-VISION with the generator, the generator must be equipped with the "Q-Connect" option, which provides an OCP Interface Board (AY40-073S) that enables Ethernet connectivity to the generator's Logic Board AY40-006S.

The Q-VISION OCP monitor is intended for use as a "touch-screen" input device; however, a keyboard and mouse are provided for use by field service technicians if and when it becomes necessary to perform operations external to the Q-VISION program environment (such as when performing operating system functions).

The Q-VISION OCP can be placed directly on a flat surface such as a table top or desk, or on can be wall-mounted using Wall Mount option QGV-WM. Refer to the Q-Connect Option System Interconnection Diagram in Chapter 6, DIAGRAMS and proceed as follows:

1. Connect AC power adapter plug to power jack on the All-in-One PC (Q-VISION) in accordance with manufacturer's instructions (provided with PC).
2. If optional keyboard and/or mouse are provided, connect these in accordance with manufacturer's instructions (provided with PC).
3. Connect Ethernet cable from All-in-One PC (Q-VISION) to an Ethernet Switch provided with Q-VISION OCP.
4. Connect Ethernet cable EL75-058-XXX between Ethernet Switch and Generator OCP Interface Board (AY40-073S) connector J1 (see Figure 2-24a).
5. Install the Ethernet Switch Power Supply connector, and plug transformer into 110 VAC, 60Hz electric outlet (220 VAC, 50Hz power source applica-

tions are compatible with the supplied dual voltage power adaptor). See Figure 2-24b.

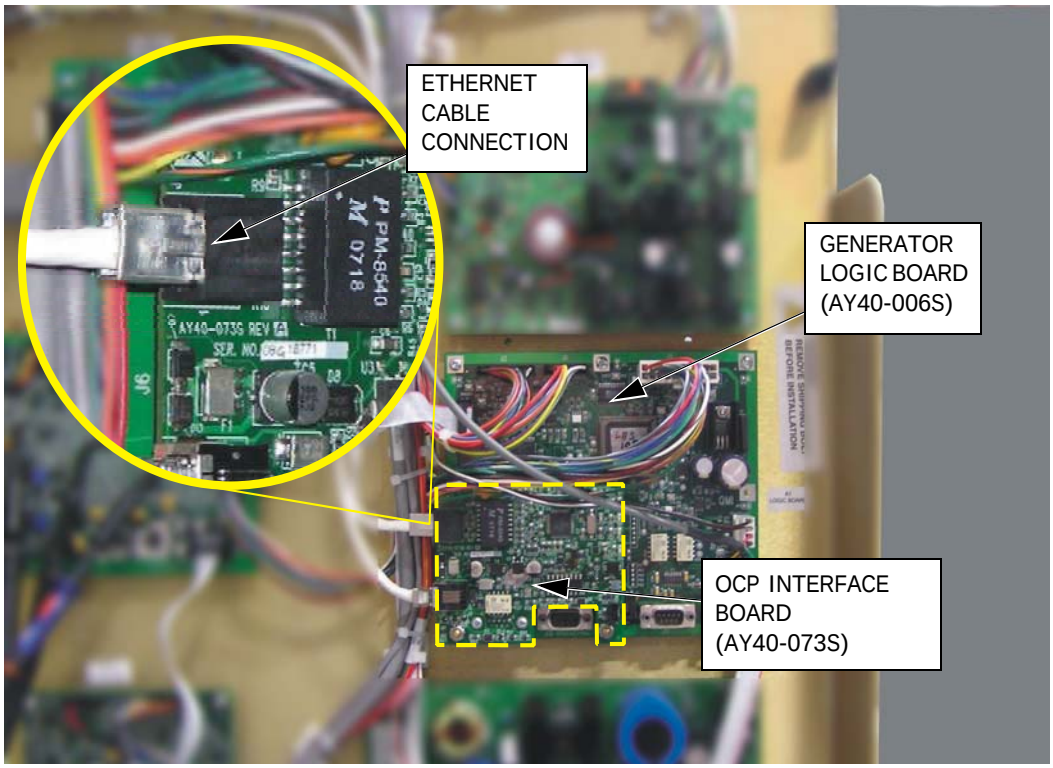


Figure 2-24a. OCP Interface Board - AY40-073S (Ethernet Connection)

Figure 2-24b. Ethernet Switch Box (Grounded)

6. The Power/Expose Control Box (AY20-271) must be installed between the Generator and the "Non-patient Area" in which the Q-VISION OCP and the Operator will be positioned. The Power/Expose Control Box should be securely mounted in close proximity to the Operator's position for easy access to the ON/ STANDBY Switch, and in clear view of the Q-VISION OCP. A 30-inch expansion cable for the 2-stage Expose Switch is hard-wired to the Power/Expose Control Box.

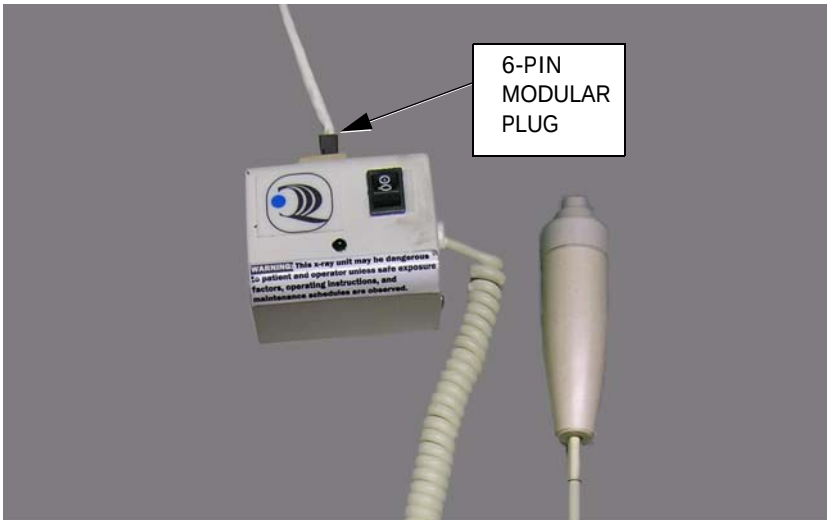


Figure 2-24c. Power/Expose Control Box

7. A prefabricated 50-ft. or 100 ft. cable with 6-pin modular plugs (AY51-243-XXX), is supplied for connecting the Power/Expose Control Box to the generator OCP Interface Board (AY40-073S). See Figure 2-24c. **DO NOT** route cable through an opening in the generator containing a High Voltage Cable (see Figure 2-13).
8. On systems provided with a Wall Mount Kit (option QGV-WM), install the wall mount components (VESA Mount Adapter, VESA Mount Plate, and Wall Mount Bracket) in accordance with instructions provided with the Wall Mount Kit.
9. Ensure wall attachment hardware is suitable for wall construction type (each screw capable of supporting 25 lbs. pull load).

Integrated Workstation Operator Control Panel

If the generator is to be integrated with an external digital imaging workstation computer for operation as a generator control panel, the "Q-Connect" option must be installed in the generator. This option provides an Ethernet adapter to enable connection of the generator to the workstation personal computer (PC). Typically, this adapter is factory installed, and is ready for use when the unit is shipped. If the Q-Connect Ethernet adapter is needed,

upgrade kits are available (contact Quantum Technical Support for more information).

Refer to the Integration System Service Manual provided, depending on the the type system integration, for system interconnection and software installation instructions. A general Q-Connect Option System Interconnection Diagram is provided in Chapter 6, DIAGRAMS in this manual for reference.

Optional Remote Expose Switch Connection

This option is not applicable on generators equipped with Q-Connect option. Optional remote expose switch (R80-HS) is wired into the OCP Board A16A1 (P/N AY40-004S) at TB1 as shown in Figure 2-25, below. If desired, removing jumpers JP6 and JP7 on OCP Control Board A16A1 (AY40-004S1) disables the operation of the PREP and EXPOSE buttons on the operator control panel (see figure below).

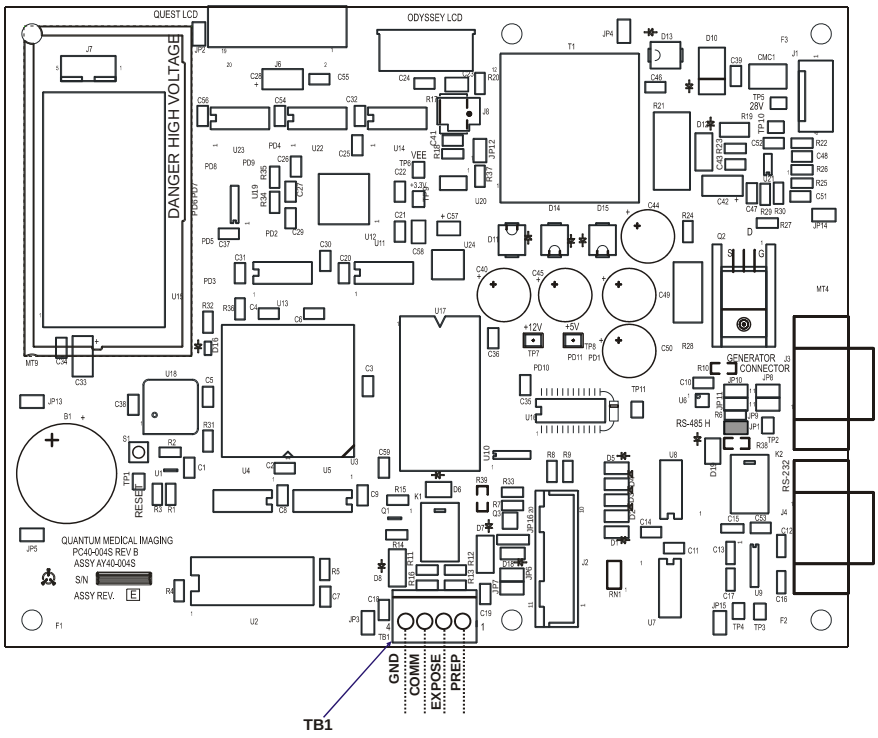


Figure 2-25. Operator Control Panel (OCP) Control Board Terminal Block TB1 Connections for Remote Expose Switch

INITIAL POWER UP

With the generator completely assembled and when electrical checks are complete, the system is ready for initial power up. Proceed as follows:

1. Set ON/OFF circuit breaker CB1 on the generator cabinet to ON position.
2. Set the power on/standby switch on the Operator Control Panel or Power/ Expose Control Box on Q-VISION equipped generators to the on (⊙) position.
3. The system begins the start up sequence (the "Welcome Screen" is displayed and "Testing. Standby." is flashing). After a few seconds, the normal operation screen will display.

IMPORTANT! If the system is a STORED ENERGY (SE) type, and it has been longer than one month since being shipped from factory, allow the system approximately four hours to re-charge the batteries before taking any exposures. The system must be turned on with auto-shutoff disabled to re-charge. Refer to "Generator Time-out Setting" paragraph in Chapter 3, CALIBRATION for detailed instructions.

4. If necessary, the operator control panel LCD display intensity can be increased or decreased by adjusting the rotary potentiometer on the rear side of the operator console.

TRANSFORMER TAP VALIDATION

1. On single-phase non-SE versions, using a DMM, measure the DC voltage across the (+) and (-) terminals of the Anode DC capacitor bank (i.e., C13-C16). The voltage should be 400 (±20) VDC. If not, re-check line voltage and adjust transformer taps as required. (Refer to "Transformer Line Adjustment" procedure in this chapter for detailed instructions.)
2. On SE versions, verify that 220VAC (±10%) exists between A8P1-4 and A8J1-7. If these voltages are out of range, test the incoming AC line and confirm the correct taps have been selected at TB1. Monitor the charger output voltages at A8TP2 (positive supply) and A8TP3 (negative supply) while allowing the chargers to recharge the battery tray(s) until each test point rises to ±205 (±1.0) VDC. Note: Charging to these levels may take up to 2 hours. If these levels cannot be achieved, check the integrity of the batteries in the affected side of each tray.
3. On three-phase models (see Figures 6-49 and 6-50), correct transformer tap connections will yield
   220 VAC measured between phases A, B and C as follows:
   a. Phase A located on Line Monitor Board A8 Fuse F4.
   b. Phase B located on Line Monitor Board A8 Fuse F5.
   c. Phase C located on Line Monitor Board A8 Fuse F6.
   d. In addition, using a DMM, measure 265 VAC between terminal block TB1 (neutral) and each Phase A, B and C.

DC voltage measurement should be made across the (+) and (-) terminals of the anode DC capacitor bank (i.e., capacitors C13 - C16). The measured voltage should be +400 (±20) VDC. If not, re-check line voltage and adjust transformer taps as required to achieve as close to +400 VDC as possible.

Q-VISION OPERATOR CONTROL PANEL - NETWORK SETTINGS VERIFICATION

NOTE! Both the generator cabinet and Q-VISION network IP addresses are set at the factory to assure initial communication between the two components. If the generator will be conncetred to the internet (such as when utilizing the remote servicing feature), the factory default IP addresses must be changed in accordance with facility Inoformation Technology (IT) administrator's requirements.

If system is equipped with a Q-VISION operator control panel, verify Generator Network Settings as follows:

1. Set ON/OFF circuit breaker CB1 on the generator cabinet to ON position.
2. Set the power on/standby switch on the Power/Expose Control Box to the on (⊙) position.
3. The system begins the start up sequence. After a few seconds, the Q-VISION control panel screen will display.

4. Touch the Help button located on the lower right corner of the Q-VISION screen (shown on right). The Generator Help Services Screen (Figure 2-25a) appears:

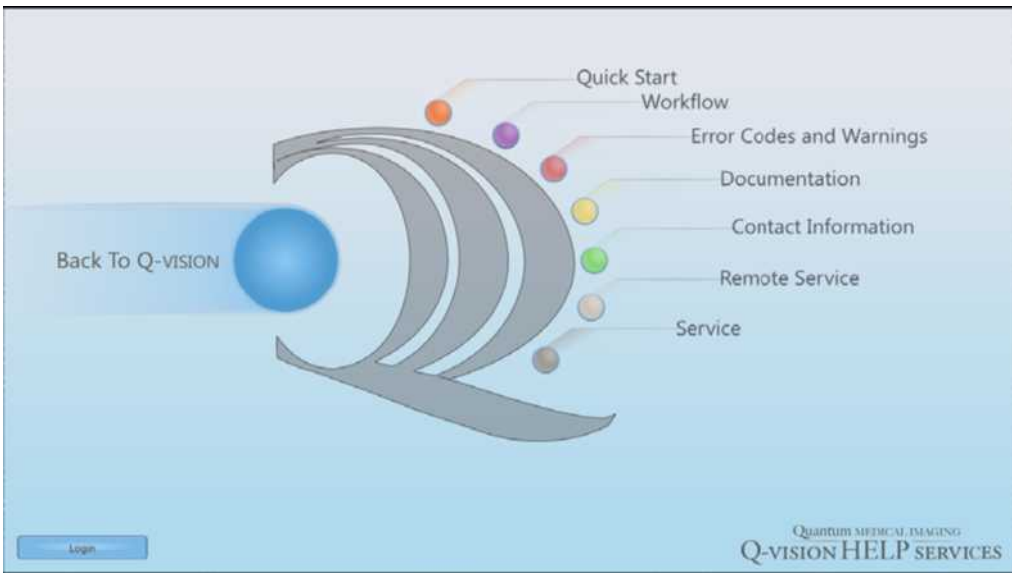


Figure 2-25a. Generator Help Services Screen

5. Touch the Login button at the lower left corner of the screen. A password entry keypad displays.

Figure 2-25b. Enter Password Screen

6. In the Enter Password screen, enter the default Service Technician password (58623) using the keypad, then select **Enter**. The word "Login" is replaced with "FieldTech" on the Generator Help Services screen to indicate successful login.

7. On the Generator Help Services screen, select **Service** option. The General Service Options Menu appears:

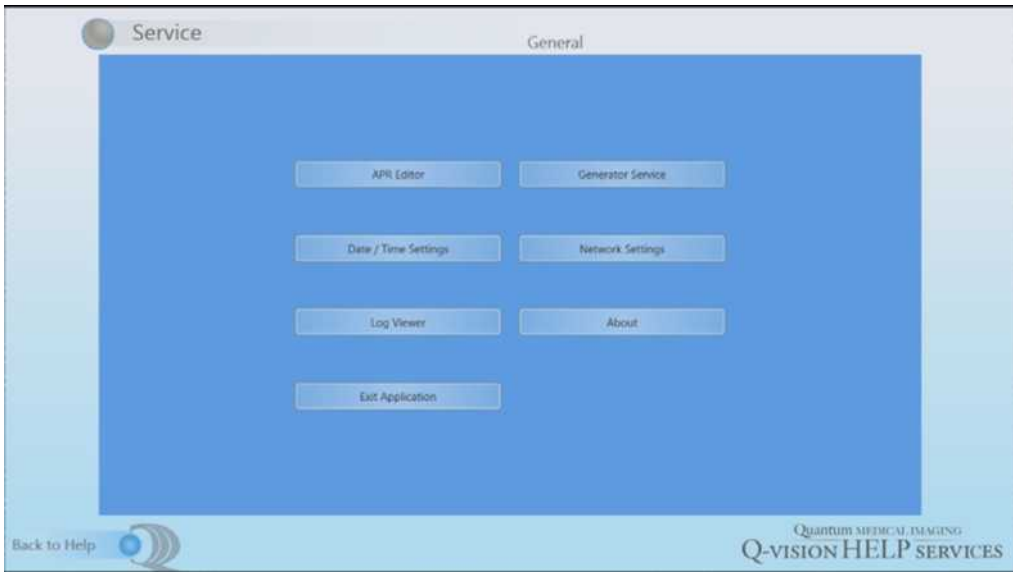


Figure 2-25c. General Service Options Menu

8. Select **Network Settings**. The following screen appears:

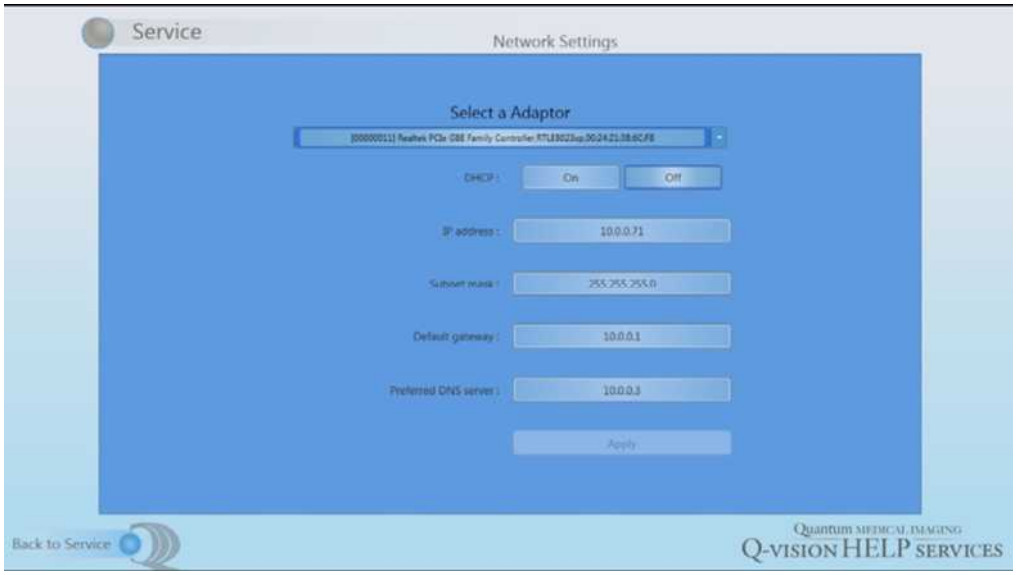


Figure 2-25d. Network Settings Screen

9. The Network Settings Screen displays the network configuration settings of the personal computer housed within the all-in-one Q-VISION operator control panel. Verify the fields are set as follows:

- DHCP = Off
- IP Address = 10.0.0.71
- Subnet mask = 255.255.255.1
- Default gateway = 10.0.0.1
- Preferred DNS server = 10.0.0.3

10. If necessary, each of these fields can be modified by selecting the field, and then entering the correct information using the data input Touch Pad that appears. Note that the touch pad display includes numerical input buttons 0 through 9, including a decimal point, a plus sign (+), a minus sign (-), a clear (Clr) button, a delete (Del), a Cancel button and an Enter button; however, erroneous input via the numbers buttons will cause the displayed address to turn red, indicating that an error has been made either in acceptable value or entry format. Should an input error occur, it can be corrected by touching the Del button, followed by touching the correct key. The Clr button clears the Address window, and allows immediate re-entry of Address values.
11. Touch the **Apply** button to save new settings.
12. Return to the Generator Help Services Screen by touching the **Back to Service** button at lower left corner of screen.
13. On the Generator Help Services screen, select **Generator Service**. The Generator Service Options Menu appears:

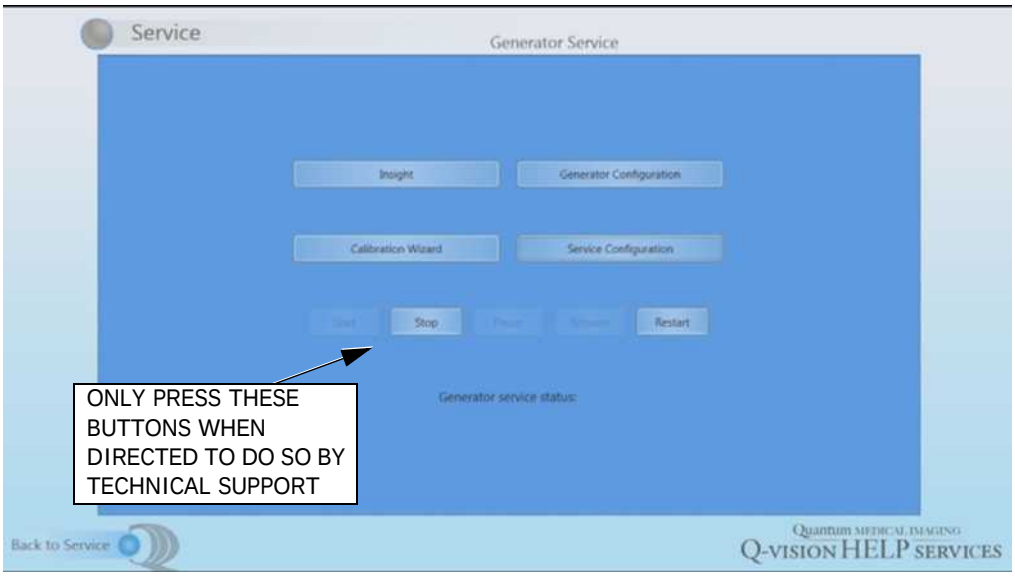


Figure 2-25e. General Service Options Menu

14. Select **Service Configuration**. The following screen appears:

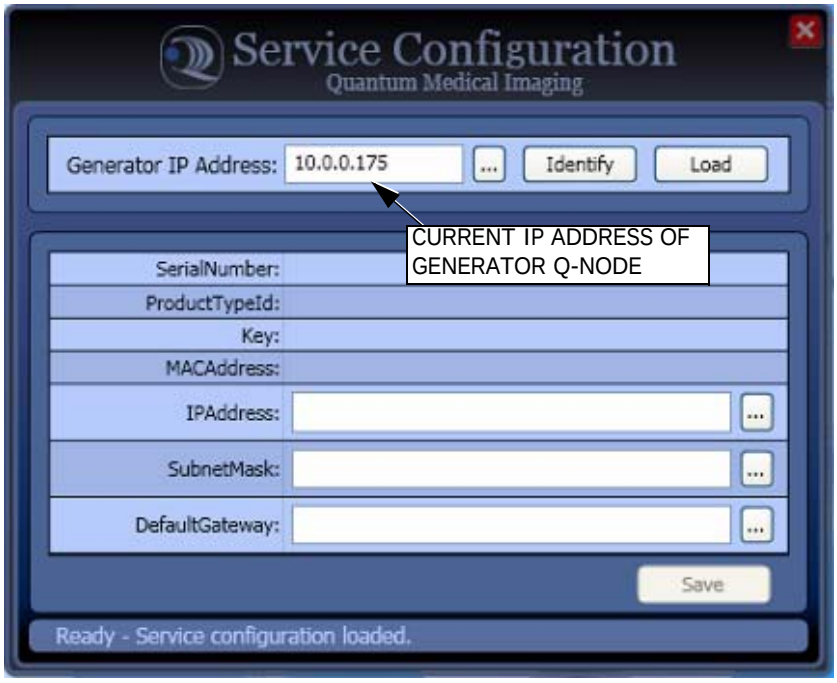


Figure 2-25f. Service Configuration Screen

15. The Service configuration Screen displays the network configuration settings of the generator cabinet, specifically of the Q-Node board (located on the Logic Board A1), which is a component of the Q-Connect generator option. The current Generator IP Address appears in the **Generator IP Address** field as shown in Figure 2-25f (10.0.0.175 is assigned at the factory as the default address).

16. Touch the **Identify** button. An audible tone will be emitted by the Power/ Expose Control Box if the Q-VISION OCP and the generator cabinet IP are communicating properly via the ethernet network connection.

17. If the generator IP address needs to be changed, press the **Load** button to causes the lower portion of the "Service Configuration" screen to populate with data relevant to the Generator with the IP Address shown in the top portion of the screen, as shown below:

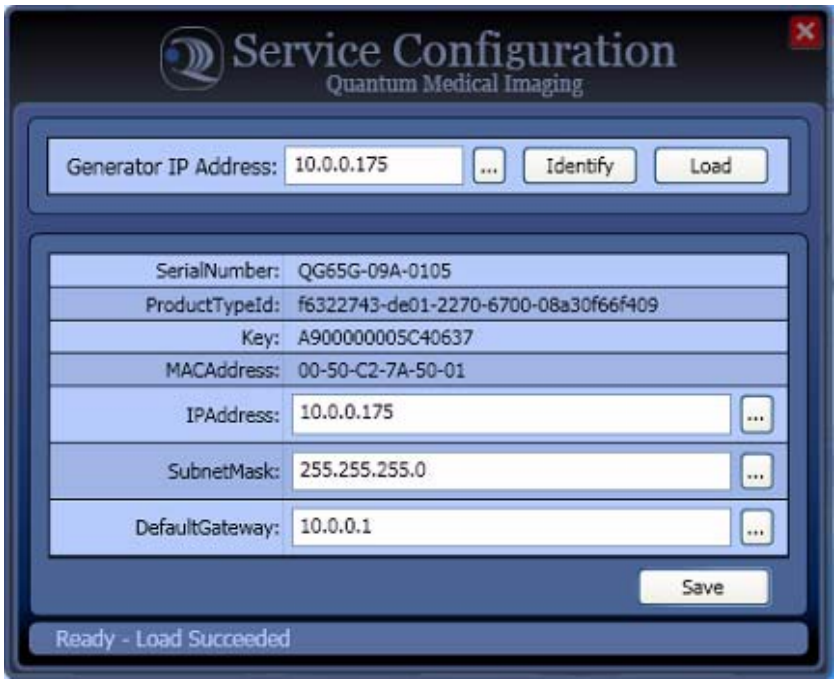


Figure 2-25g. Service Configuration Screen

18. To change the IP Address, SubnetMask, or DefaultGateway field, touch the ... button to the right of the field to open a data input Touch Pad, which operates in the same manner as described previously on the Network Settings Screen.

19. After all changes are made, touch **Save** button. This saves the new IP Address settings for the Generator.

Note: The Generator Q-Node and Q-VISION Subnet Addresses must match in order for the Service Configuration program to become operational. Once communication between the Q-VISION OCP Computer and the Generator has been established, the technician may then set the Generator IP Address in accordance with instructions provided by the cognizant IT professional for the facility at which the System is installed.

ROTOR DRIVE BOARD A10 (AY40-013T) PERFORMANCE VERIFICATION

Note: This procedure is not required on systems equipped with high speed starter option.

Refer to Rotor Drive Board A10 (AY40-013T) Terminal Block Location Diagram in Chapter 6, DIAGRAMS and verify Rotor Drive Board adjustments as follows:

1. Set A10R20 to approximately mid range.
2. Connect one channel of oscilloscope to A10TP15 and second channel to A10TP14.
3. Press and hold the PREP key for approximately 3 seconds. Verify that during the **run** cycle, the amplitude of the phase and main pulses are +14 VDC to +15 VDC and waveforms are as shown in Figure 2-26 (i.e., the peaks of waveforms at TP15 and TP14 should be between 2.5 and 3.0 milliseconds apart).

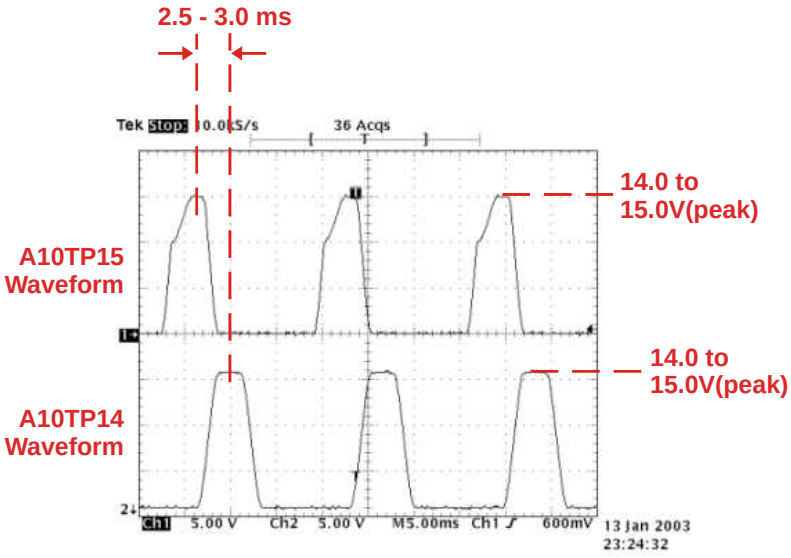


Figure 2-26. Rotor Board Phase and Main Pulses

4. Press and hold PREP key for approximately 3 seconds.
5. Verify the peak voltage at A10TP14 after PREP has been pressed for at least 2 seconds (rotor in **boost** mode) is *greater than* 14 V_{PEAK}. If necessary, adjust A10R20 to achieve the correct voltage.
6. Set A10R24 to approximately midrange.
7. Press and hold PREP key for approximately 3 seconds.

8. Verify the peak voltage at A10TP15 after PREP key has been pressed for at least 2 seconds (rotor in **boost** mode) is *greater than* 14 V_{PEAK}. If necessary, adjust A10R24 to achieve the correct voltage.
9. Connect a DMM between A10TB1-1 and A10TB1-3.
10. Press the PREP key and verify the voltages as follows:
    - For 110 VAC stator tubes (Toshiba E7242X, E7813X, E7252X, E7239X) **96 - 140 VAC during boost, 54 - 66 VAC during run**
    - For 220 VAC stator tubes (all others tubes not listed above) **183 - 227 VAC during boost, 54 - 66 VAC during run**
11. Install cabinet cover.
12. Proceed with system calibration procedure described in Chapter 3, CALIBRATION.

Chapter 3

CALIBRATION

OVERVIEW

This chapter provides instructions for configuring and calibrating the HF Series X-ray generator following installation. For additional information, NEMA Standards Publication/No. XR8-1979(R1994), Test Methods for Diagnostic X-ray Machines for Use During Initial Installation is recommended as a reference.

IMPORTANT NOTE: If the generator is equipped with the Q-Connect option" (Ethernet Adapter) for Agfa DiRex Integration (i.e., the Agfa NX workstation computer functions as the operator control panel), proceed to Appendix B, CALIBRATION (Agfa DiRex) for generator configuration and calibration instructions.
If the generator is equipped with the "Q-Connect option" (Ethernet Adapter) for use with a Q-VISION operator control panel (OCP), or it is integrated with a workstation computer other than an Agfa DiRex Integration (e.g., the Canon DR Integration System, Agfa NX-DR Series Integration), refer to Appendix D, CALIBRATION (Insight - Canon) for generator configuration and calibration instructions.

REQUIRED TOOLS AND MATERIALS

The following lists the tools and materials required to perform the procedures contained in this chapter:

- Digital Voltmeter: Fluke Model 87 (or equivalent)
- kV and mAs meter: Radcal Dynalyzer III (or equivalent)
- Radiation meter (0-1000 mR)
- Oscilloscope, 50 Mhz storage: Tek 2210 (or equivalent)
- 5 CM, 10 CM, 15 CM, 25 and 30 CM acrylic phantoms (required for calibrating systems equipped with QG-AEC option).

SYSTEM CONFIGURATION/CALIBRATION

The HF Series x-ray generator has been factory configured and calibrated. It is necessary, however, to perform the following procedures to validate system compliance. Perform the procedures in the sequence presented, unless otherwise instructed.

ACCESSING SERVICE MODE

Calibration and configuration can only be performed by accessing the X-ray generator's Service Mode. To gain access to the Service Mode, password entry is required. This is to prevent unintended and/or unauthorized changes to system settings. To access the Service Menu, proceed as follows:

1. Set the ON/OFF circuit breaker CB1 on the generator cabinet to ON position.
2. Set the power on/standby switch on the Operator Control Panel (OCP) to the standby (⏻) position, then to the on (⊙) position.
3. The "Welcome Screen" appears with "Testing. Stand by." displayed in the lower portion of screen (see Figure 3-1.).

Figure 3-1. Welcome Screen

4. Within five seconds of start up, press the upper left field select key as shown in Figure 3-1). The Password menu displays:

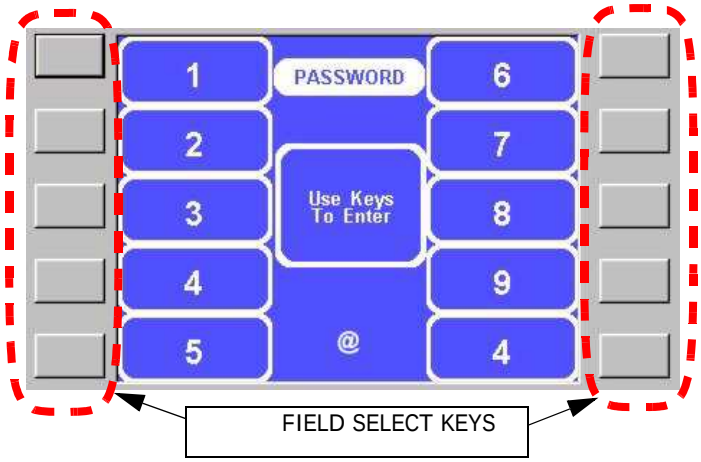


Figure 3-2. Password Menu

5. In the Password menu, enter the default Service Technician password (**58623**) using the field select keys next to the corresponding numbers. (This password enables access to Service Mode for modification of system configuration, calibration and settings and for access to the APR Edit utility.)
6. Upon validation of the password, the Service Mode Menu displays:

Figure 3-3. Service Menu

The Service Menu offers a selection of service-oriented system utilities, each of which is described briefly below:

- **Configuration** utility: Provides access to system configuration settings, such as AEC type, rotor drive settings, tube type, etc.
- **Calibration** utility: Provides access to system calibration functions, such as filament, mA, kVp calibration and, if equipped with QG-AEC option, AEC and film/screen calibrations.
- **Reports** utility: Provides access to Service Reports menu, which provides Generator, Tube, Error Warnings, and Diagnostic reports (refer to Chapter 5, SERVICE MAINTENANCE for more information).
- **Self-Test** utility: Currently not accessible.
- **Last Calibration Date**: Currently not accessible.
- **Settings** utility: Provides access to system settings, such as the language, date, time, date format (international or U.S.) and backup time/mAs settings.
- **APR Edit** utility: Used to edit existing APR screens or use to create new screens (refer to Chapter 4, APR EDITOR in the operator's manual for more information).

Pressing the key next to the **Exit** field returns the system to the Start Up screen (see Figure 3-1).

SYSTEM CONFIGURATION

Press the key next to the **Configuration** field to access system configuration functions. The Service Configuration Menu displays:

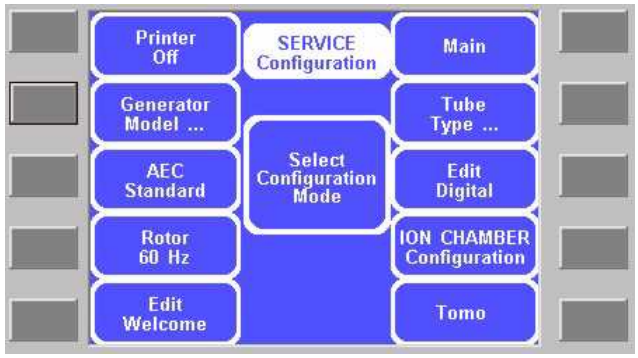


Figure 3-4. Service Configuration Menu

The Service Configuration Menu provides access to the system's configuration settings. For proper operation of the generator, the settings must accurately reflect the actual configuration of both the generator and the components to which it is interfaced. Typically, these settings are made at the factory in accordance with sales order specifications. However, it is recommended that you review the current configuration settings for accuracy. The following briefly describes the various Service Configuration Menu selections:

- **Printer**: Enables data output to an external label printer when one is interfaced to the generator
- **Generator Model** setting: Accesses the generator maximum power output derating setting (from 80% to 100%). Access to other functions is restricted to authorized QMI factory personnel only
- **AEC** setting: displays AEC option setting (i.e., AEC "Standard", AEC "Universal", AEC OFF)
- **Rotor Drive** setting: Accesses the rotor drive settings - 60 Hz (no high speed starter), 50 Hz (no high speed starter), Quantum internal high-speed starter (QMI HSS), or AID external high-speed starter (AID HSS)
- **Edit Welcome/Facility**: Accesses the facility name text editing and, on ODYSSEY systems, the dealer name text editing utilities, which provide functions necessary to edit the information appearing on the "Welcome Screen" displayed during start-up
- **Main**: returns the system to the Service Menu (see Figure 3-3)
- **Tube Type** setting: Accesses the Tube Type Setting screen, for selection of x-ray tube model used with system
- **Edit Digital**: Accesses the digital receptor settings including digital receptor type (i.e., Canon, Konica, CMT, Generic, or NONE), Universal system type (i.e., Quantum QV-800, Pausch COSMOS-2, or NONE), and PREP HOLD setting (on or off).

- **Ion Chamber Configuration** setting: Accesses the Ion Chamber Configuration screen, which is used to configure each ion chamber interfaced with the system (two separate ion chambers, of either slope or level type, can be interfaced to the generator)
- **Tomo** setting - Accesses the Tomo configuration screens for setting up the system for interfacing with the Siemens or Pausch tomography systems (available settings are Siemens, Pausch, or OFF (none))

To change a configuration setting, press the key next to the configuration selection to be changed. After all configuration settings are set appropriately, press the key next to the **Main** field. The configuration settings are saved in non-volatile read-only memory (NVROM) and the system returns to the main Service Menu (see Figure 3-3).

The following paragraphs provide specific instructions for setting each of the available configuration selections.

Printer On/Off Setting

When configured to do so, the HF Series X-ray generator will print post-exposure factors (kVp, mA, time, mAs, etc.) to an externally interfaced device such as a label printer. The label printer must comply with the following serial communication protocol: *9600 baud rate, no handshake, 1 start bit, 1 stop bit, no parity.* To connect a printer, attach an RS-232 serial cable between the printer and the RS-232 A16J2 9-pin connector on the rear panel of the Operator Control Panel.

The Service Configuration Screen displays the current printer setting. When set to **On**, the generator will provide serial output data to an externally connected printer. When set to **Off**, serial data output for a printer is disabled.

Note: The printer setting has no affect on upload or download functionality using Q-Ware software.

Generator Configuration / Derating Settings

The Generator Configuration Screen, shown below, displays the generator model and the power output derating setting (presented as a percentage of total power output (kW) capacity).

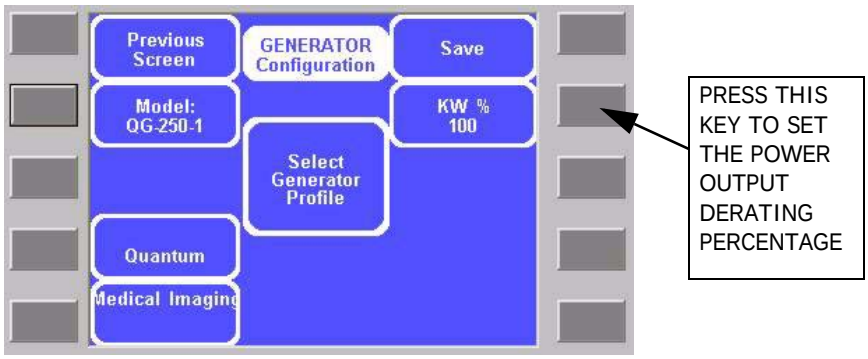


Figure 3-5. Generator Configuration Screen

The power output derating function is used to limit the power output of the system to a percentage of the maximum power capacity. For example, on a 50 kW system, setting the "KW%" to 90% will limit the maximum power output to 45 kW (50kW x .9 = 45kW). To set the power output derating, proceed as follows:

1. Press the key next to the **KW %** field to choose a derating percentage (choices are 80%, 85%, 90%, 95% or 100% [i.e., no derating]).
2. Press the key located next to the **Save** field. The derating percentage setting is saved in non-volatile read-only memory (NVROM) and the system returns to the Service Configuration Menu (see Figure 3-4).

AEC Setting

The Service Configuration menu, shown below, displays the generator's current AEC setting.

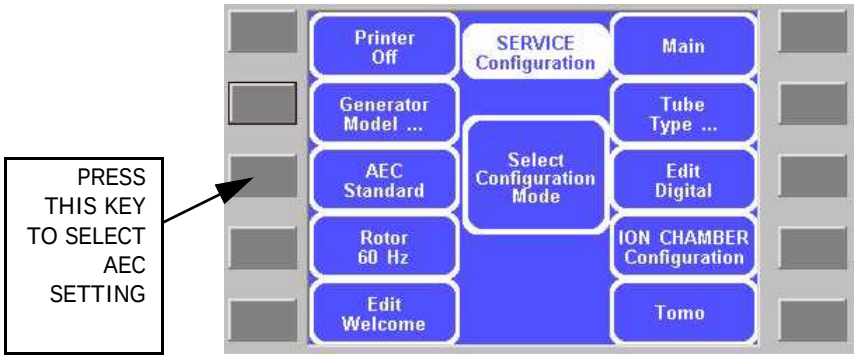


Figure 3-6. Choosing AEC Setting

1. Verify the AEC setting is correct as follows:
   - Select "AEC Standard" if generator is equipped with standard type AEC Board A11 (AY40-031S)
   - Select "AEC Universal" if generator is equipped with universal type AEC Board A11 (AY40-027S)
   - Select "AEC OFF" if generator is not equipped with optional AEC
2. Press the key located next to the **AEC** field to select the appropriate AEC setting.
3. To exit the screen and return to the Service Menu, press the key next to the **Main** field.

Rotor Drive Setting

The Service Configuration Menu, shown below, displays the current tube rotor drive setting. The tube rotor drive setting is pre-set at the factory and normally should not be changed (unless replacement of tube with different type). If you need to change the tube rotor drive setting, proceed as follows:

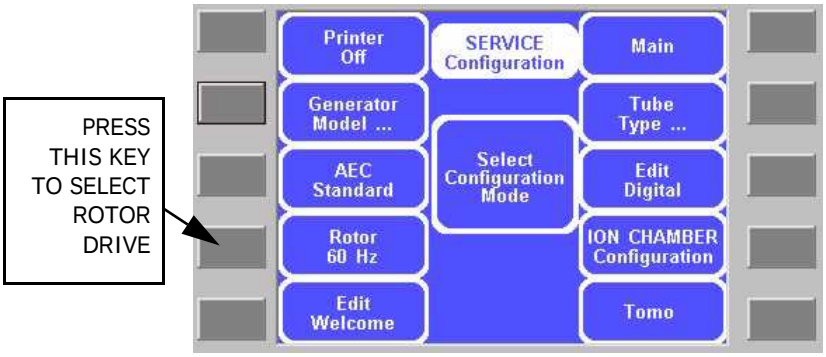


Figure 3-7. Rotor Drive Configuration Menu

1. Press the key located next to the **Rotor** field to scroll through the available rotor drive settings (60 Hz, 50 Hz, QMI HSS, or AID HSS).
2. To exit the screen and return to the Service Menu, press the key next to the **Main** field.

NOTE: On systems equipped with high-speed starter option (HSS), tube "high-speed" mode will only be activated when selected exposure factors exceed the limits used for low-speed operation.

Edit Facility/Welcome Facility Utility

The Edit Facility/Edit Welcome utility allows editing of the Facility and Dealer names as they appear on the Welcome Screen, which displays when the system is first turned on (see Figure 3-1).

Selecting **Edit Welcome** from the Service Configuration menu opens the Edit Welcome menu, which offers a choice of editing either the facility name or the dealer name. Either choice will open the Edit Sentence screen (see Figure 3-8).The editing functions available in the Edit Facility and Edit Dealer screens are identical to those used in the Edit Sentence screen described in Chapter 4, APR EDITOR of the operator's manual. (Note: The maximum number of characters for the facility nameor dealer name field is 48.)

Figure 3-8. Edit Facility/Edit Welcome Screen

Tube Type Setting

The Tube Configuration Screen, shown below, displays the current tube model setting. Also provided are the Heat Alarm (Heat % Limit) and Tube Derating (Tube%) functions. The tube model setting is preset at the factory and normally should not be changed, except after replacing the existing tube with a different type tube. *(Note: Consult Quantum Service Department before attempting to re-configure generator with a tube type that is different than the factory-configured tube type.)*

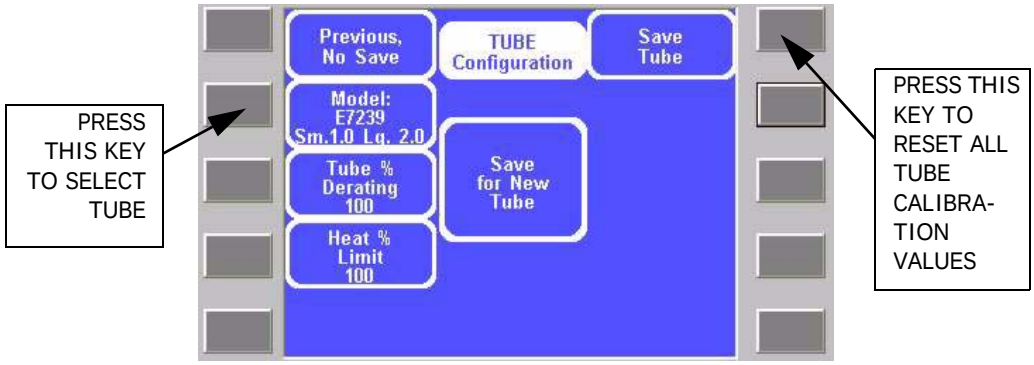

PRESS THIS KEY TO SELECT TUBE
Previous, No Save
TUBE Configuration
Save Tube
Model: E7239 Sm.1.0 Lg. 2.0
Tube % Derating 100
Heat % Limit 100
Save for New Tube
PRESS THIS KEY TO RESET ALL TUBE CALIBRA-TION VALUES

Figure 3-9. Tube Configuration Screen

CAUTION! Pressing the Save Tube key will require system re-calibration, including AEC calibration. In addition, tube statistics will be cleared. Proceed only if necessary.

1. Press the key located next to the **Model** field until the correct tube model is displayed.
2. The Tube Derating key provides derating of the generator's maximum mAs output in percentages of 80%, 85%, 90%, 95% or 100% (i.e., no derating). For example, if at a particular kV and mA the tube normally allows a 10 mAs exposure, then at 80% derating, the tube would permit only an 8 mAs exposure. Derating the tube can extend the life of the tube. Press the key next to the **Tube % Derating** field to choose a derating percentage.
3. The Heat Alarm (Heat % Limit) key provides a heat protection function for the x-ray tube. For example, setting the Heat Alarm for 80% will cause the generator to produce an audible alarm and a visual "Heat Alarm" indication on the OCP when the tube has reached 80% of its total heat unit capacity. The total tube heat unit capacity is dependent on the tube type. The Heat Alarm setting has an adjustment range of anywhere between 50% up to 100% in 10% increments. *Note: At 100% setting, the heat alarm is effectively disabled.* Press the key next to the **Heat % Limit** field to select the percentage of the total tube heat capacity at which alarm activation will occur.

4. If the tube type has been changed, press the **Save Tube** key. The tube model setting is saved in non-volatile random access memory (NVRAM) and the system returns to the Service Configuration Menu (see Figure 3-4). Note that if the **Previous, No Save** key is pressed when the tube type is changed, any changes made in the Tube Configuration Screen will not be saved (i.e., the previous tube's calibration values will be retained).

Edit Digital Settings

The Edit Digital Screen, shown below, contains the Digital Receptor settings, including the digital receptor type, Universal System type, and "Prep Hold" settings for the generator. To make these settings, proceed as follows:

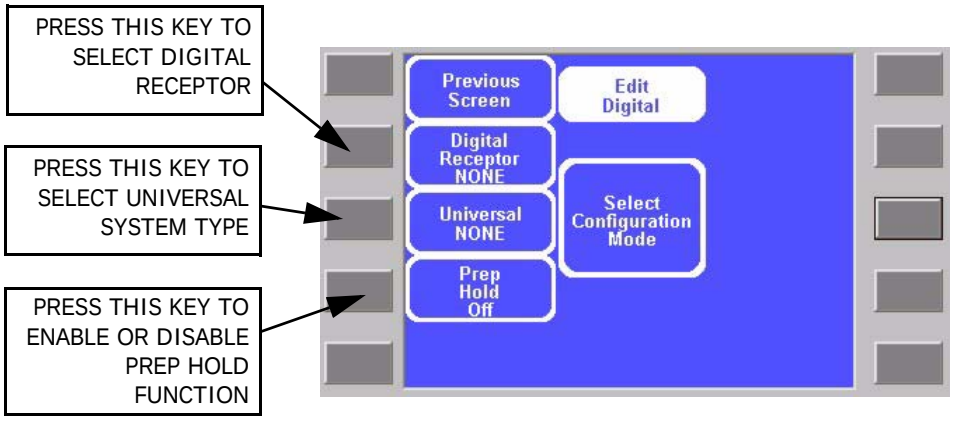

PRESS THIS KEY TO SELECT DIGITAL RECEPTOR
PRESS THIS KEY TO SELECT UNIVERSAL SYSTEM TYPE
PRESS THIS KEY TO ENABLE OR DISABLE PREP HOLD FUNCTION
Previous Screen
Edit Digital
Digital Receptor NONE
Universal NONE
Prep Hold Off
Select Configuration Mode

Figure 3-10. Edit Digital Screen

1. To set the Digital Receptor type, press the key located next to the **Digital Receptor** field until the correct digital receptor setting is displayed (**Canon** = Canon digital receptor installed, **Konica** = Konica digital receptor installed, **CMT** = CMT digital receptor installed, **NONE** = non-digital receptor installed, including all CR systems).
2. The Universal setting is used to enable or disable operator selection of a table receptor when the generator is used with a "Universal" C-arm x-ray system, such as the Quantum **QV-800** or Pausch **COSMOS-2** system or with a Canon CXDI-50G portable DR receptor using two ion chambers (wall and table). When set to **NONE**, the table receptor is selectable by the operator.
3. Setting the Prep Hold setting to **ON** configures the generator to send a "Prep Hold" signal to the DR system (notifies the DR system that a Prep cycle has been initiated; the generator must receive a "Prep Hold Release" signal from the DR system to proceed with the Expose cycle). Setting the Prep Hold setting to **Off** configures the generator for "normal" operation (i.e., non-interrupted Prep cycle).
4. To exit the screen and return to the Service Menu, press the key next to the **Previous Screen** field.

Ion Chamber/Receptor Configuration

The Ion Chamber Configuration Screen, shown below, displays available ion chambers that can be interfaced to the HF Series X-ray generator. This screen also provides relay on/off settings for activating either the table and/or wall receptor when the receptor keys on the OCP are pressed.

Note: On systems equipped with a "Standard" type AEC (i.e., the generator is equipped with standard type AEC Board A11, AY40-031S), the "Ion Chamber Wall 2" and "Ion Chamber Auxiliary" selections are not used. These choices are only effective if the generator is configured with "Universal" type AEC (i.e., if generator is equipped with universal type AEC Board A11, AY40-027S").

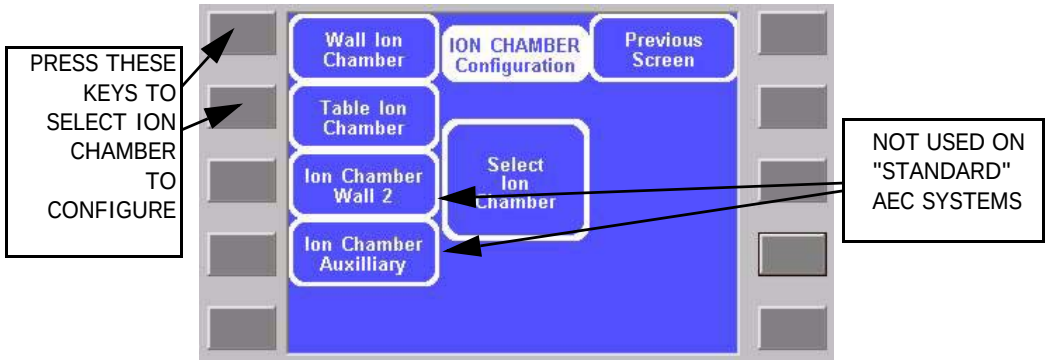

PRESS THESE KEYS TO SELECT ION CHAMBER TO CONFIGURE
Wall Ion Chamber
ION CHAMBER Configuration
Previous Screen
Table Ion Chamber
Ion Chamber Wall 2
Select Ion Chamber
Ion Chamber Auxilliary
NOT USED ON "STANDARD" AEC SYSTEMS

Figure 3-11. Ion Chamber Configuration Screen

1. Press the key located next to the ion chamber you want to configure: **Wall Ion Chamber**, **Table Ion Chamber**, **Ion Chamber Wall 2**, or **Ion Chamber Auxilliary** (**Ion Chamber Wall 2** and **Ion Chamber Auxilliary** only used on systems equipped with AEC Board A11, AY40-027S). Be sure that the selected ion chamber is properly interfaced to the AEC Board A11 as described in Chapter 2, ASSEMBLY & INSTALLATION.)

2. The system displays the ION CHAMBER Configuration Screen, as shown in the example below:

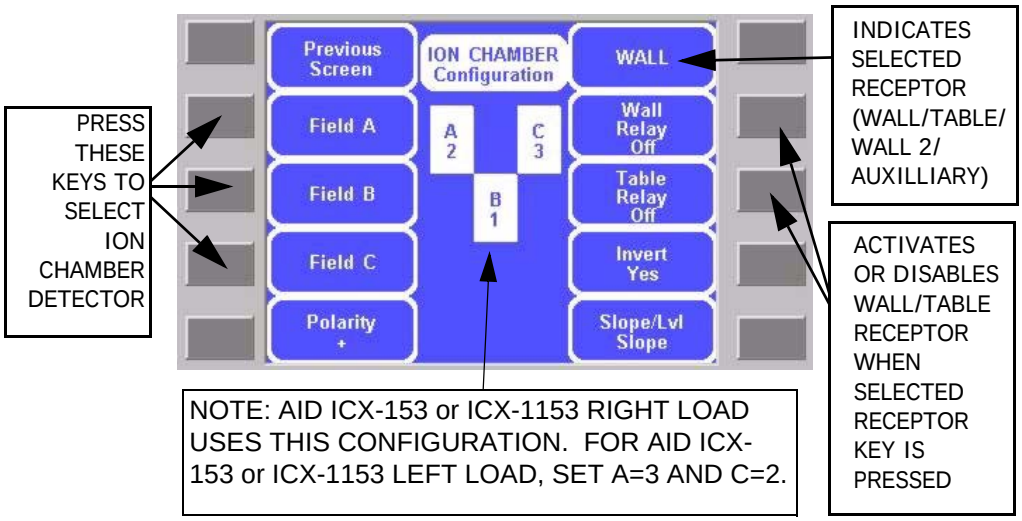

Previous Screen
ION CHAMBER Configuration
WALL
Field A
A 2
C 3
Wall Relay Off
Field B
B 1
Table Relay Off
Field C
Invert Yes
Polarity +
Slope/Lvl Slope
PRESS THESE KEYS TO SELECT ION CHAMBER DETECTOR
INDICATES SELECTED RECEPTOR (WALL/TABLE/ WALL 2/ AUXILLIARY)
ACTIVATES OR DISABLES WALL/TABLE RECEPTOR WHEN SELECTED RECEPTOR KEY IS PRESSED
NOTE: AID ICX-153 or ICX-1153 RIGHT LOAD USES THIS CONFIGURATION. FOR AID ICX-153 or ICX-1153 LEFT LOAD, SET A=3 AND C=2.

Figure 3-12. ION CHAMBER Configuration Screen (AID ICX-153 or ICX-1153 Right Hand Load Configuration Shown)

The ION CHAMBER Configuration Screen displays the assignment of ion chamber detectors (detector A, B, or C) with respect to the generator's ion chamber detector select signals (i.e., FIELD SELECT 1, FIELD SELECT 2 and FIELD SELECT 3) output from AEC Control Board A11 (AY40-031S/ AY40-027S). In other words, assigning "1" to field "A" will enable ion chamber detector "1" when the UPPER LEFT chamber detector field is selected on the Operator Control Panel (OCP).

The ION CHAMBER Configuration Screen also provides settings that facilitate proper interfacing of the generator with different ion chamber and receptor types. These include Polarity, Wall Relay ON/OFF, Table Relay ON/OFF, Invert, and Slope/Level settings.

Ion Chamber Configuration

Configure the Wall and/or Table ion chamber as follows:

IMPORTANT: The AID ICX-153 or ICX-1153 ion chamber, which is the default chamber type shipped with standard AEC type generators, requires that detector "A" = 2, "B" = 1, and "C" = 3. The factory default orientation of the ion chamber mounting in the bucky is with the front side toward the tube. However, it may be necessary to mount the chamber with the back side forward (e.g., for left side loading wall stands). In this case, in the ION CHAMBER Configuration screen, simply switch assignment of chamber detector A to "3" and detector C to "2". No wiring modifications are necessary.

Table 3-1. Ion Chamber Configuration Settings for Generator with Standard AEC (AEC Board AY40-031S is Installed)

	Standard AEC Systems	
Setting	**Wall Ion Chamber Settings**	**Table Ion Chamber Settings**
Polarity	+	+
Wall Relay	Off	Off
Table Relay	Off	Off
Invert	No	No
Slope/Lvl	Slope	Slope

Table 3-2. Ion Chamber Configuration Settings for Generator with Universal AEC Option (Requires AEC Board AY40-027S)

	Universal AEC Systems					
	Ion Chamber Type					
	Siemens (Level)		AID (Slope) Tomo Systems		AID (Slope) Non-Tomo Systems	
Setting	**Wall Ion Chamber Settings**	**Table Ion Chamber Settings**	**Wall Ion Chamber Settings**	**Table Ion Chamber Settings**	**Wall Ion Chamber Settings**	**Table Ion Chamber Settings**
Polarity	+	+	+	+	+	+
Wall Relay	On	Off	On	Off	On	Off
Table Relay	Off	On	Off	On	Off	On
Invert	Yes	Yes	No	No	No	No
Slope/Lvl	Level	Level	Slope	Slope	Slope	Slope

Table 3-3. Ion Chamber Configuration Settings for Generator with Digital Interface Option (Requires Digital Interface Board AY40-034T)

	Digital Receptor Systems (w/AY40-031S)	
Setting	**Wall Ion Chamber Settings**	**Table Ion Chamber Settings**
Polarity	+	+
Wall Relay	On	Off
Table Relay	Off	On
Invert	No	No
Slope/Lvl	Slope	Slope

Table 3-1 shows the ion chamber and receptor settings for the generator when equipped with standard AEC (i.e., Standard AEC Board A11 (AY40-031S) is installed). Table 3-2 shows the ion chamber and receptor settings for the generator when equipped with universal AEC (i.e., Universal AEC Board A11 (AY40-027S) is installed). Table 3-3 shows the ion chamber and receptor settings for the generator when equipped with standard AEC and "Digital Interface" option (i.e., Standard AEC Board A11 (AY40-031S) and Digital Interface Board A9 (AY40-034T) are installed). Detailed instructions are as follows:

1. Press the key located next to the ion chamber detector (**Field A, Field B or Field C**) until the desired detector setting (1, 2, 3 or Off) is indicated in corresponding box of ion chamber graphic on the right side of the ION CHAMBER Configuration screen (see Figure 3-12).
2. The "Polarity" setting (**+** or **-**) controls whether the ion chamber on the selected receptor port is a (+) positive logic (i.e., active high) or (-) negative logic (i.e., active low) model. The positive logic model presents a DC voltage or ramp ranging from 0 to some positive voltage to indicate exposure value. The negative logic model presents a DC voltage or ramp ranging from 0 to a negative voltage. This setting is ignored unless the "Universal AEC" selection is chosen. The "Standard AEC" board is always "positive".
3. The "Invert" setting controls the sense of the signals that select the individual field for the chamber. If "Invert" is set to **No**, the idle (non-PREP/EXPOSE) state of the individual field selection is "1" and the state during PREP/EXPOSE is "0" if the field is selected (called "Low Active"). If "Invert" is set to **Yes** the idle (non-PREP/EXPOSE) state of the field selection is "0" and the state during PREP/EXPOSE is "1" if the field is selected (called "High Active"). This setting is ignored unless the "Universal AEC" selection is chosen. The "Standard AEC" board is always "Not Inverted".

4. The "Slope/Lvl" setting determines if the ion chamber connected to the selected receptor AEC output is of the "slope/ramp" (Slope) or a DC Level (Level) type. This setting is ignored unless the "Universal AEC" selection is chosen. The "Standard AEC" board is always "Slope".
5. When all ion chamber settings are appropriately configured, press the key located next to the **Previous Screen** field.
6. Repeat above steps for each of the other ion chambers interfaced with the generator.

Receptor Relay Configuration

The "Wall Relay" setting controls whether the "Wall Relay" on the Universal AEC Board A11 AY40-027S is energized. Similarly, the "Table Relay" setting controls whether the "Table Relay" on the Universal AEC Board A11 AY40-027S is energized. These settings provide +28 VDC output for operation of a Siemens bucky. If this field is set to **ON**, the relay is asserted when:

- The receptor switch that accesses this receptor is depressed on the OCP panel or
- When an APR Technique requests this receptor.

The wall or table relay will remain energized until a receptor with "Wall Relay" **OFF** or "Table Relay" **OFF**, respectively, is selected.

Depending on the configuration of the generator, set the receptor relays as indicated in Table 3-1, 3-2, or 3-3.

Tomo Setting

Important! On generators that will be interfaced to a tomography system; Set Tomo Mode to "Off" prior to performing generator calibration, then set Tomo Mode back to "On" following calibration.

The generator may be interfaced to operate with either a Siemens or Pausch tomography system (refer to Chapter 2, ASSEMBLY & INSTALLATION for wiring instructions). The generator must be equipped with a "Universal" type AEC Board (i.e., AEC Board A11 (AY40-027S) must be installed). To configure the generator for tomo operation, proceed as follows:

1. Select **Tomo** from the Service Configuration Menu (see Figure 3-4). The system displays the Tomo menu (see Figure 3-13).

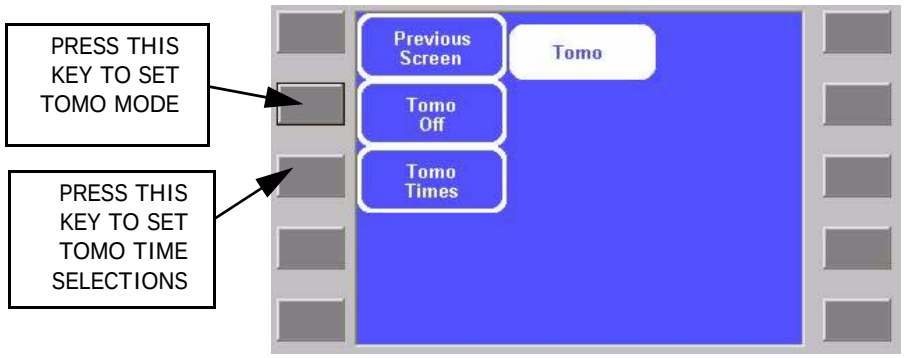


Figure 3-13. Setting Tomography System Interface Configuration

2. Press the key next to the **Tomo** field until the desired tomography system interface setting (Siemens, Pausch, or OFF (none)) is displayed. If no tomography option is interfaced, set to **OFF**. Otherwise, set to either **Siemens** or **Pausch** as required.

3. Press the key next to **Tomo Times** field. Depending on whether "Siemens" or "Pausch" tomo was selected, the appropriate Tomo Times screen (see Figure 3-14 or 3-15) is displayed:

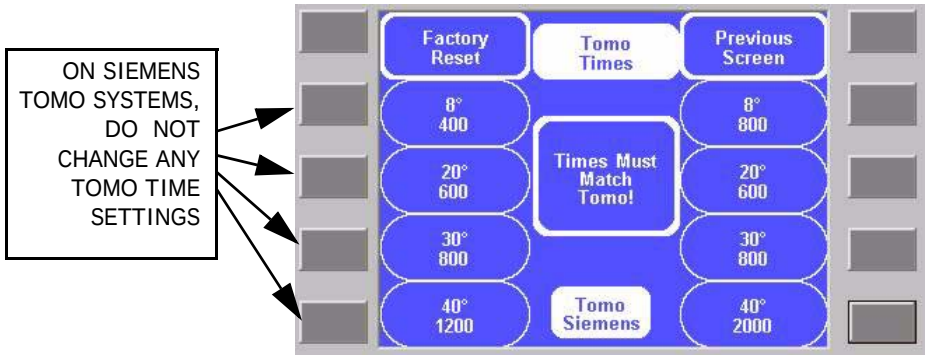


Figure 3-14. Tomo Times Screen - Siemens Tomo Selected

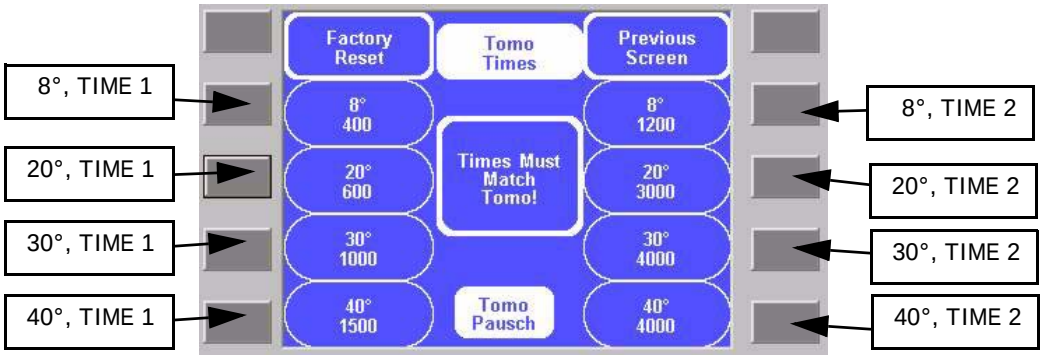


Figure 3-15. Tomo Times Screen - Pausch Tomo Selected

4. Press the **Factory Reset** key. All tomo sweep time settings will be set to factory default values as shown in the sample screens above (the time values shown are in milliseconds). Depending on the type tomography system, proceed as follows:

   a. If interfacing to a Siemens tomography system, do not change any of the default tomo sweep time settings. The settings must reflect the values shown in Figure 3-14. Press the key next to **Previous Screen** field to exit Tomo Times screen.

   b. If interfacing to a Pausch tomography system, the default tomo sweep times for each key on the tomo system are shown in Figure 3-15. These values may be changed as desired by the user. The time range for each key is from 0.4 seconds (400 milliseconds) up to 4.0 seconds (4000 milliseconds). Please note that the last key (40°, TIME 2) is non-configurable in the current generator design; this output is parallel connected to (and therefore will have the same time setting) as the 40°, TIME 1 output.

   IMPORTANT: When interfacing the generator to a Pausch tomography system, be sure to set the tomo sweep times on the generator, as described above, to correspond exactly with the tomo sweep times programmed on the Pausch system.

   c. Verify all tomo times are correct and then press the key next to the **Previous Screen** field to save and exit.

SYSTEM SETTINGS

In the Service Menu (see Figure 3-3), press the key next to the **Settings** field to access the Service Settings Menu, shown below:

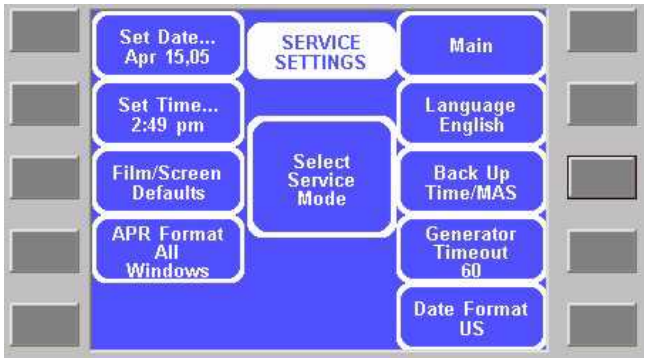


Figure 3-16. Service Settings Menu

The Service Settings Menu provides access to various system settings. The following briefly describes the various Service Settings Menu selections:

- **Set Date** setting: Accesses the Set Date Screen for setting current date
- **Set Time** setting: Accesses the Set Time Screen for setting current time
- **Film/Screen Defaults**: Sets the film/screen combination that is used as the default for each of the available receptors used with the generator (i.e., Wall 40", Wall 72", Table 40", Wall2, and/or Auxilliary receptor). This setting applies to AEC and APR AEC mode exposures only. Each receptor used with the system requires that AEC calibration be performed using the selected film/screen combination.
- **APR Format**: Configures the APR Procedure Screens to display or not display the Film Speed and/or CM (thickness) screen fields when the generator is operated in APR mode.
- **Main**: returns the system to the Service Menu (see Figure 3-3)
- **Language** setting: Sets language used for operator control panel display screens/menus (i.e., English, French, Spanish, German, or Italian).
- **Back Up Time/MAS** setting: Displays current, system-wide, AEC exposure back up mAs setting (only functions on systems equipped with QG-AEC option). The system allows for selection of a mAs setting between 10 and 600 mAs (in 10 mAs increments). Note: APR procedures have a separately configurable back up time/mAs setting which, when lower in value, will override the system back up time/mAs setting. Refer to APR Edit chapter in the Operator's Manual for APR procedure back up time/mAs settings.

- **Generator Timeout**: Sets the delay time for generator to automatically shut down if no keys are pressed on operator control panel (selectable in 30 minute increments between 0 minutes up to 180 minutes). *If "0" is selected, the generator will not timeout, however, the filament will turn off if one hour of inactivity.*
- **Date Format** setting: Sets date/time format (options are "US" or "International)

To change a setting, press the key next to the system setting you want to change. After all system settings are set appropriately, press the key next to the **Main** field. The system settings are saved in non-volatile random access memory (NVRAM) and the system returns to the main Service Menu (see Figure 3-3).

The following paragraphs provide specific instructions for configuring each of the above system settings.

Set Date Screen

The Set Date screen, shown below, displays the current date setting. To change the date setting, proceed as follows:

Figure 3-17. Setting the Date

1. Adjust the month, date or year setting using the appropriate keys as shown in Figure 3-17, above, until desired date is displayed.
2. To exit the screen and return to the Start Up Screen, press the key next to the **Main** field.

Set Time Screen

The Set Time screen, shown below, displays the current time setting. To change the time setting, proceed as follows:

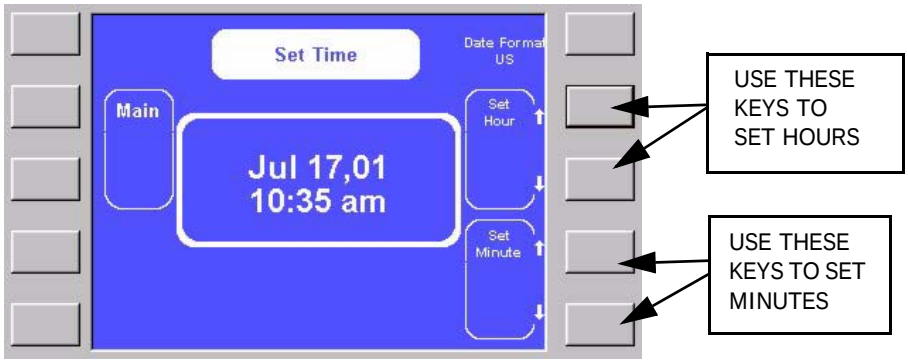


Figure 3-18. Setting the Time

1. Adjust the hours or minutes setting using the appropriate keys as shown in Figure 3-18, above, until desired time is displayed.
2. To exit the screen and return to the Start Up Screen, press the key next to the **Main** field.

Film/Screen Defaults Screen

The Film/Screen Default Screen (see Figure 3-19) is used to configure the default film/screen combination for the various image receptors used with the generator. This setting applies to AEC and APR AEC mode exposures only. If the selected film/screen combination has not already been calibrated, it must be calibrated according to the AEC Calibration procedures later in this chapter using the selected film/screen combination setting.

The generator has been pre-configured with seven different film/screen combination selections designated "Wall 40"", "Wall 72"", "Table 40"", "100 Speed", "200 Speed", "800 Speed", and "Film/Screen7". If the Digital Receptor setting in Service Configuration Menu is enabled, an eighth option entitled "Digital" will be also be selectable. Note that the factory default film/screen combination names may be changed using the film/screen combination name edit utility as described in Service Manual.

The Film/Screen Defaults screen, shown below, displays the current receptor film/screen combination settings. To change the default film/screen settings, proceed as follows

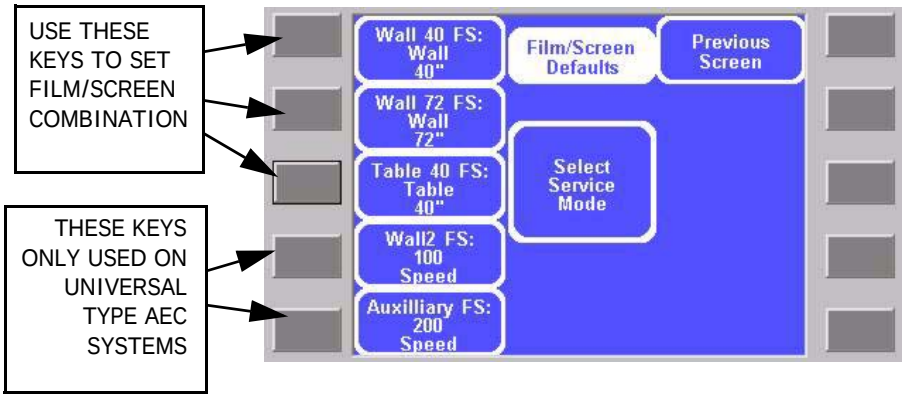

USE THESE KEYS TO SET FILM/SCREEN COMBINATION
THESE KEYS ONLY USED ON UNIVERSAL TYPE AEC SYSTEMS
Wall 40 FS: Wall 40"
Wall 72 FS: Wall 72"
Table 40 FS: Table 40"
Wall2 FS: 100 Speed
Auxilliary FS: 200 Speed
Film/Screen Defaults
Previous Screen
Select Service Mode

Figure 3-19. Film/Screen Defaults Screen

1. **Wall 40 FS** setting: Press the key next to the **Wall 40 FS:** field until the desired film/screen combination name appears. The selected film/screen combination is now the film/screen combination used when "WALL 40" image receptor is selected for exposures using AEC and APR AEC mode exposures.
2. **Wall 72 FS** setting: Press the key next to the **Wall 72 FS:** field until the desired film/screen combination name appears. The selected film/screen combination is now the film/screen combination used when "WALL 72" image receptor is selected for exposures using AEC and APR AEC mode exposures.
3. **Table 40 FS** setting: Press the key next to the **Table 40 FS:** field until the desired film/screen combination name appears. The selected film/screen combination is now the film/screen combination used when "TABLE" image receptor is selected for exposures using AEC and APR AEC mode exposures.
4. **Wall2 FS** setting (enabled only generators equipped with "Universal" type AEC [i.e., AEC Board A11 AY40-027S is installed]): Press the key next to the **Wall2 FS:** field until the desired film/screen combination name appears. The selected film/screen combination is now the film/screen combination used when "WALL2" (AUX) image receptor is selected for exposures using AEC and APR AEC mode exposures.
5. **Auxilliary FS** setting (enabled only generators equipped with "Universal" type AEC [i.e., AEC Board A11 AY40-027S is installed]): Press the key next to the **Auxilliary FS:** field until the desired film/screen combination name appears. The selected film/screen combination is now the film/screen combination used when "AUX" image receptor is selected for exposures using AEC and APR AEC mode exposures.

NOTE

The "default" film/screen combination settings automatically link specific calibrated film/screen combinations used in non-APR and APR exposures using AEC. However, the operator may choose any available calibrated film/screen combination using the Film/Screen selection keys provided in the AEC and APR mode screens.

APR Format Setting

The APR Format Setting key (shown below) permits the operator to configure the APR Procedure Screens to display or not display the Film Speed and/or CM (thickness) screen fields when the generator is operated in APR mode. To change the APR Format setting, proceed as follows:

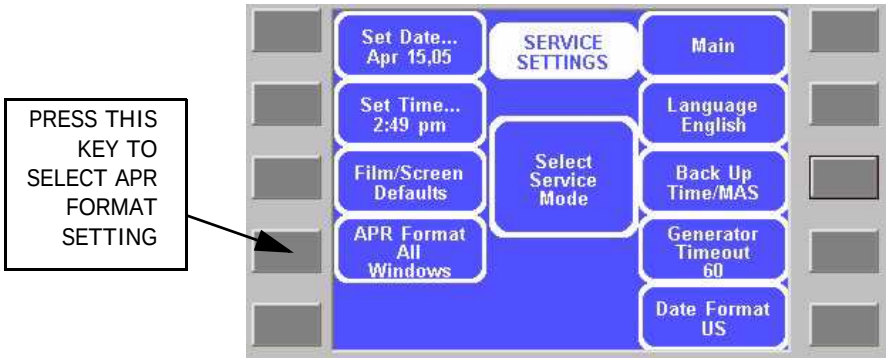


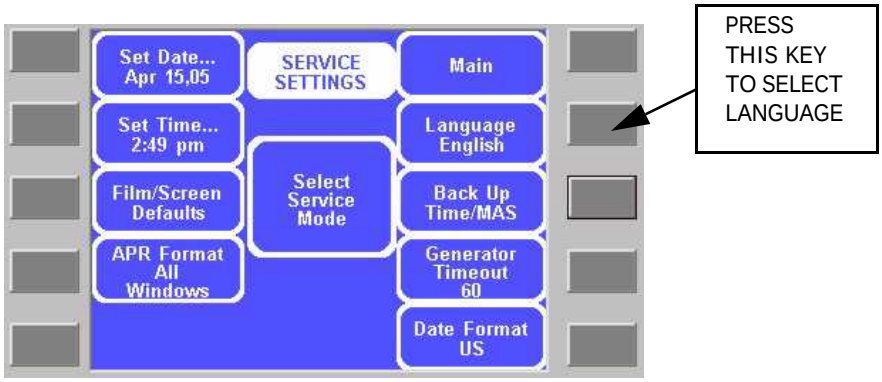
Figure 3-20. Choosing Language and Date Format Settings

Press the key next to the **APR Format** field to scroll through available APR Format options:

- **All Windows** - APR Procedure Screens will display both Film Speed and CM (thickness) screen fields
- **No CM** - APR Procedure Screens will not display the CM (thickness) screen field
- **No FS** - APR Procedure Screens will not display the film speed screen field
- **No FS, No CM** - APR Procedure Screens will not display the film speed nor the CM (thickness) screen fields

Language Setting

The Service Settings Menu, shown below, displays the current language setting. The default language setting is English. To change the language setting, proceed as follows:



NOTE

It may be preferable to set the Language to "English" prior to performing calibration procedures, then reset to the desired language after calibration is completed.

Figure 3-21. Choosing Language and Date Format Settings

Press the key next to the **Language** field to scroll through available languages (English, French, Spanish, German, Italian, etc.) until desired language is displayed.

Back Up MAS Setting

The AEC Backup Setting screen, shown below, displays the current AEC backup mAs setting. Note that this is the system-wide backup mAs setting, and as such, will be effective on all AEC exposures. The procedure-specific back up time is set using the APR Edit function (refer to APR Edit chapter in the Operator Manual for instructions on setting individual procedure backup mAs). *Note: The lower of the two backup settings will take precedence when set to unequal values.*

To change the system-wide backup mAs setting, proceed as follows:

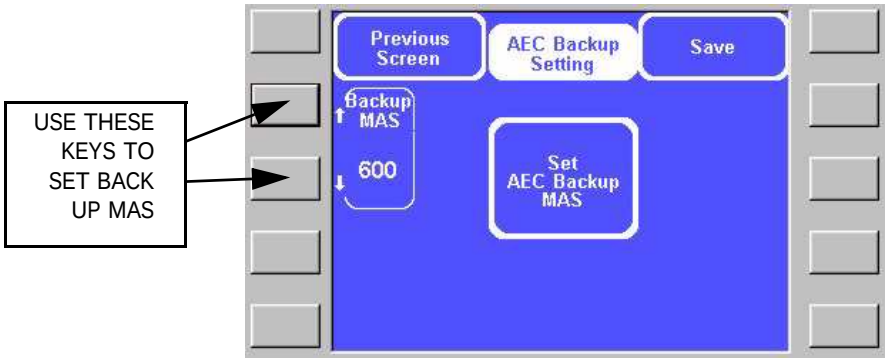


Figure 3-22. Choosing an AEC Backup MAS Setting

1. Adjust the backup mAs setting using the appropriate keys as shown in Figure 3-22 above until desired backup mAs is displayed. The maximum back up mAs setting is 600; note that on certain model generators, such as the Stored Energy models, the maximum mAs capability of the generator is less than 600 mAs. Therefore, the backup mAs setting should not exceed the maximum MAS output of the generator. Refer to Chapter 1, SPECIFICATIONS for a list of the mAs ratings by model number.
2. To save the indicated backup mAs setting and return to the Service Settings Menu, press the key next to the **Save** field or the **Previous Screen** field.

Generator Timeout Setting

The Service Settings Menu, shown below, displays the current automatic generator power shutdown setting. The time period selected represents the amount of delay time, after which if no user activity is detected, the system automatically enters Automatic Power Stand By mode. This mode is entered to help reduce power consumption while protecting system electronics. To set the generator time-out setting, proceed as follows:

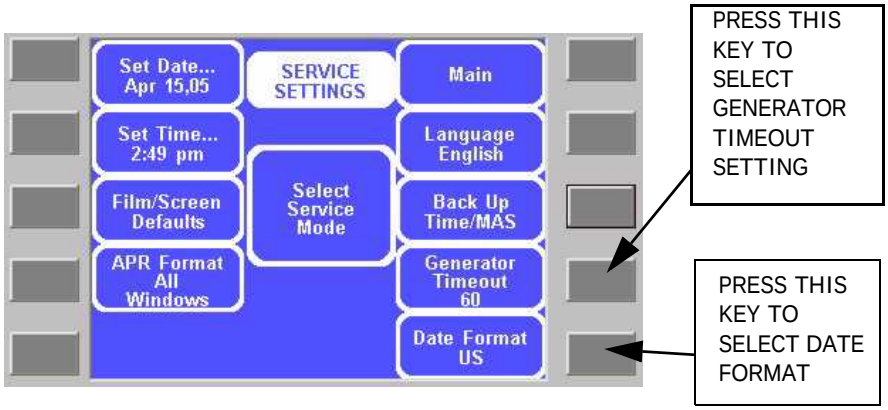


Figure 3-23. Setting Generator Timeout Setting

Press the key next to the **Generator Timeout** field to scroll through available time period settings (0, 30, 60, 90, 120, 150, 180 minutes) until desired setting is displayed. Note: Selecting "0" disables automatic timeout function.

Date/Time Format Setting

The Date Format field (see Figure 3-23) displays the current date/time format setting. To change the date/time format setting, proceed as follows:

1. Press the key next to the **Date Format** field to select either "US" (e.g., JUN 11,01 2:00 pm) or Int'l (e.g., 11 JUN 01 14:00) date/time format used for display of date and time on all applicable system screens.
2. To exit the screen and return to the Start Up Screen, press the key next to the **Main** field

SYSTEM CALIBRATION

CAUTION! Before calibrating unit, perform warm-up procedures recommended by tube manufacturer or the warm-up procedure described in Chapter 3 of the Operator's Manual.

Important! On generators that will be interfaced to a tomography system; Set Tomo Mode to "Off" during prior to performing generator calibration, then set Tomo Mode back to "On" following calibration.

To access the system calibration functions, press the key next to the **Calibration** field in the Service Menu (see Figure 3-3). The Service Calibration menu displays, shown below:

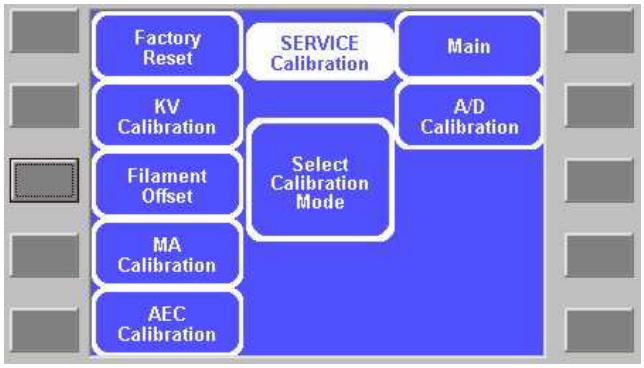


Figure 3-24. Service Calibration Menu

The Service Calibration menu provides access to the system's various calibration functions. The generator was pre-calibrated at the factory, however, the system will need to be re-calibrated to assure proper operation, verify compliance and set AEC optical density. These procedures should be performed in the order presented in this chapter. The following is a brief description of each of the Service Calibration Menu selections:

- **Factory Reset**: Accesses the Factory Reset Menu, which provides a list of resettable system calibration and configuration parameters including:
  - » Apr (user-customized APR procedures)
  - » Tube curves
  - » AEC (AEC calibration values)
  - » Sentence (Modified Sentences)
  - » History (Error Log)
  - » Objects (all other of the program variables and subroutines excluding the above parameters; includes kV, mA, and filament calibration values)

» All (all of the above)

» Ship (Reserved for factory use only)

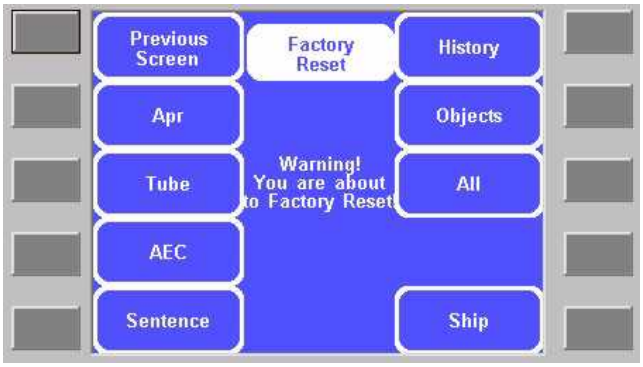


Figure 3-25. Factory Reset Menu

When reset, the selected parameter(s) are returned to factory preset (default) values. Table 3-4 shows the system configuration default values. Factory Reset may be necessary following NVRAM replacement (on OCP Control Board AY40-004S1), following tube replacement, or when abnormal values or unusual text appear in any of the system's screens. *Note: The "Q-WARE" generator software application can be used to make a back-up copy of the generator's calibration values and edited APR techniques before performing a Factory Reset. This data can later be downloaded back to the generator following reset thereby eliminating the need to re-calibrate or re-program the generator, however, re-verification is required.*

NOTE

Following a Factory Reset, the KV, filament and MA Calibration procedures, described in this chapter, must be performed before using the system.

Table 3-4. Factory Default System Settings

Setting	Default
AEC	On
ROTOR TYPE	Rotor 60 Hz
DIGITAL RECEPTOR	None
ION CHAMBERS (TABLE, WALL, WALL2, AUXILLIARY)	
DETECTORS	A=2 B=1 C=3
POLARITY	+
WALL RELAY	OFF
TABLE RELAY	OFF
INVERT	NO
SLOPE/LVL	SLOPE
WALL 40 FILM SCREEN	Wall 40"

Table 3-4. Factory Default System Settings

Setting	Default
WALL 72 FILM SCREEN	Wall 72"
TABLE 40 FILM SCREEN	Table 40"
WALL2 40 FILM SCREEN	Wall 40"
AUXILLIARY FILM SCREEN	800 Speed
LANGUAGE	English
BACKUP MAS	600
GENERATOR TIMEOUT	60
DATE FORMAT	US
APR TECHNIQUES	Factory Values

- **KV Calibration**: Accesses KV calibration function
- **Filament Offset**: Accesses tube filament offset calibration function
- **MA Calibration**: Accesses mA calibration function
- **AEC Calibration**: Accesses the AEC optical density, Reciprocity, and AEC kVp calibration functions (active on systems equipped with AEC option only). Note that all of the AEC Calibrations must be performed for each table and/or film/screen combination used with the x-ray system. Selection of each film/screen type used with the system is explained in "SYSTEM SETTINGS" paragraph contained in this chapter.
- **Main**: Returns to the Service Menu. This function is also provided in each of the calibration screens accessed from the Service Calibration
- **A/D Calibration:** Accesses the analog-to-digital (A-D) converters calibration function

To enter any of the factory default settings, press the key next to the calibration function you want to access.

The **Next Calibrate** and **Previous Calibrate** fields are provided in each of the calibration screens accessed from the Service Calibration menu. Pressing the key next to the **Next Calibrate** field advances the system to the next calibration function (menu). Pressing the key next to the **Previous Calibrate** field returns the system to the Service Calibration menu.

The paragraphs that follow describe the procedures for performing each of the above calibration functions. Following initial system installation, these procedures should be performed in the order presented in this chapter.

GENERAL CALIBRATION PROCEDURE NOTES

WARNING! The following calibration procedures involve taking x-ray exposures. All personnel should be behind the protective barriers. X-rays can be dangerous unless proper precautions and procedures are adhered to.

The following notes apply in general to all calibration procedures, including AEC calibration procedures. Please review these notes prior to performing calibration.

- The top right button typically is used to advance to the next step of a particular calibration procedure.
- Use the button next to the **Next Calibrate** field to advance to the next calibration procedure.
- Use the button next to the **Prev Calibrate** field to return to the previous calibration procedure.
- In calibration procedures having multiple "steps", the last step is indicated when "**Measure, Calibrate**" appears in the top right screen field. Pressing the key next to "**Measure, Calibrate**" field saves the calibration values. After saving the calibration values, press either the **Next Calibrate** key to proceed with the next calibration procedure or **Prev Calibrate** key to return to the previous calibrate procedure.

IMPORTANT! Following a calibration procedure, unless the "Measure, Calibrate" key is pressed, no change is made to the currently saved calibration value(s).

- The screen always displays the correct KV, MA, time and thickness (in CM) value required for performing each calibration procedural step. Ensure the correct values are set prior to performing each procedural step.
- Throughout AEC calibration, the film/screen being calibrated is displayed on every AEC calibration screen in the top left field.
- When calibrating AEC using a wall stand mounted receptor, ensure that the x-ray beam is perpendicular to image receptor and that the correct ion chamber detector(s) is selected.
- Upon completing calibration procedures, it is recommended that Q-Ware program be used to upload calibration data (and APR technique data if editing was performed) as a backup in case a problem occurs requiring re-calibration of the generator. To obtain a copy of the Q-Ware program, contact Quantum Medical Imaging's Customer Service Department.

IMPORTANT! Use the same configuration of bucky, grid, ion chamber and film cassette/screen that will be used with the "Film/Screen" being calibrated.

IMPORTANT! Always place a cassette in the holder when taking any measurements or when calibrating, even if the calibration step does not require a film to be exposed.

Film Speed Setting on non-AEC Systems

The following procedure applies only to generators not equipped with automatic exposure control (AEC) option. The factory default film speed setting for the wall 72", wall 40" and table 40" receptors is 400. If the facility uses a film with speed other than 400, it is necessary to set the generator for the appropriate film speed. Proceed as follows:

1. From the Service Calibration Menu (see Figure 3-24), press the key next to **AEC Calibration** field. The AEC Calibration Menu screen is displayed:

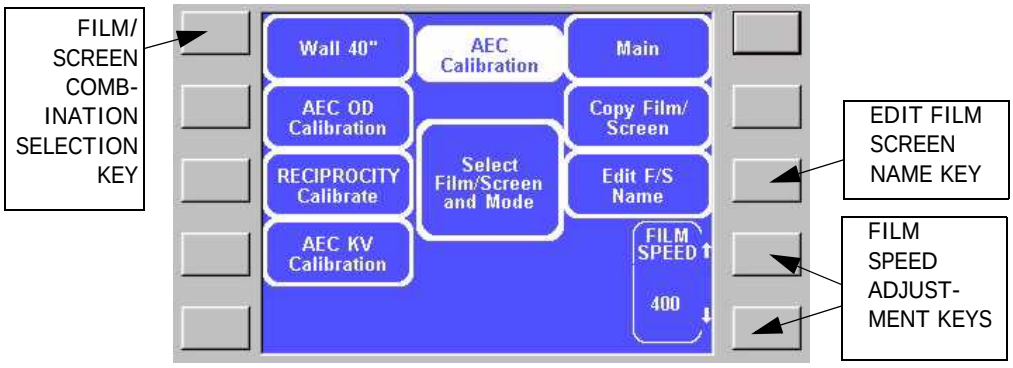


Figure 3-26. AEC Calibration Menu

2. Using the up and down keys next to the film speed field, set the film speed to the desired value.
3. If desired, the film/screen combination name can be edited. For example, the system default "Wall 40" film/screen combination name may be changed to "Kodak", "AGFA", or to whatever text is required. For instructions on film/screen combination name editing, refer to "Editing a Film/ Screen Combination Name" procedure in the AEC calibration section of this chapter.
4. Repeat above steps for both wall and table receptors, as necessary.

A/D Calibration

The A/D (analog/digital converter) calibration utility is used to adjust and calibrate specific operating voltages within the x-ray generator against a traceable calibrated voltage measurement instrument, such as a DMM. Once A/D calibration has been performed, the A/D calibration utility may then be used as a diagnostic tool allowing the technician to "read" these voltage measurements without having to remove the cover from the generator cabinet and without connecting a meter.

Table 3-5 shows the various voltage levels (with tolerances) that can be adjusted and calibrated using this utility, and it provides the location of the test point to which a calibrated voltmeter must be connected for measuring the actual voltage level:

Table 3-5. A/D Calibration Voltages

Voltage Level	Calibration Accuracy	Test Point Measurement Location
+400V Cathode	±8 VDC	+/- bus bars on Capacitor Bank next to Power Module A19 (left side looking into generator cabinet)
+400V Anode	±8 VDC	+/- bus bars on Capacitor Bank next to Power Module A18 (right side looking into generator cabinet)
+5VDC	±0.1 VDC	TP1 on Logic Board AY40-006S
+15VDC	±0.2 VDC	TP3 on KVP Control Board AY40-003S
-15VDC	±0.2 VDC	TP5 on KVP Control Board AY40-003S
+24VDC	±0.3 VDC	TP8 on Power Supply Board AY40-005T
+24V Brake	±0.3 VDC	Terminal TB2-1 on Interface Board AY40-023T (or AY40-034T)

The following procedure adjusts and calibrates the generator to verify accurate system measurement of selected operating voltages. The same procedure applies to any of the voltage levels available for selection. Voltage measurement accuracy is verified using your pre-calibrated voltmeter (traceable to NIST standard) as the benchmark. Once calibrated, the generator's CPU continuously monitors these internal voltages and will terminate or not allow exposure if certain tolerances are exceeded.

Proceed as follows:

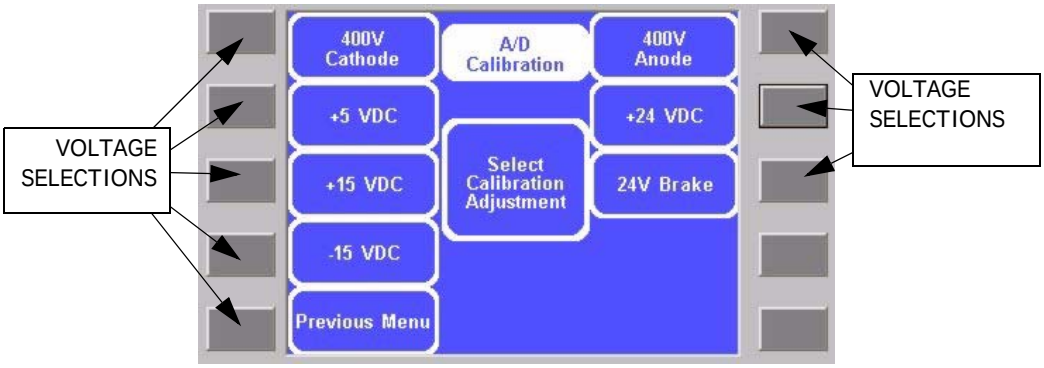


Figure 3-27. A/D Calibration Menu

WARNING! The following procedure requires that power be applied to the generator. Extreme care must be exercised to ensure the safety of service or other personnel in the area.

1. In the A/D Calibration menu, shown in Figure 3-27, select a voltage level to calibrate (choices are 400V Cathode, +5 VDC, +15 VDC, -15 VDC, 400V Anode, +24 VDC, or +24 V Brake). The A/D calibration screen, such as the sample +15 VDC calibration screen shown in Figure 3-28, is displayed:

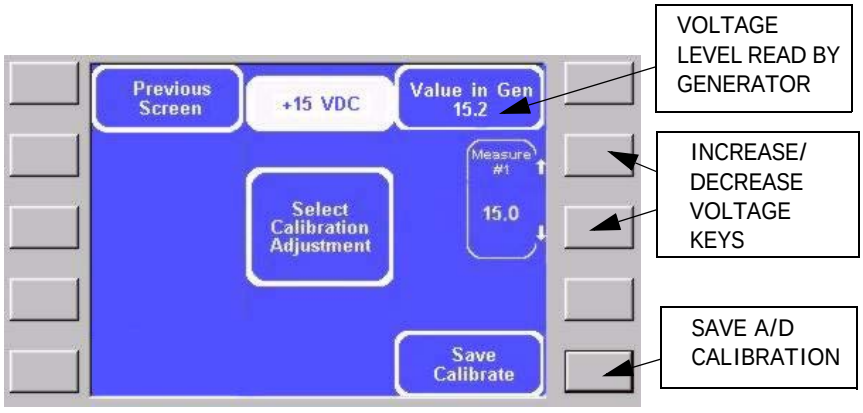


Figure 3-28. Sample A/D Voltage Calibration Screen (+15 VDC is shown)

2. Verify the voltage displayed in the top center of the screen is the correct voltage level to calibrate.
3. Refer to Table 3-5 and connect a voltmeter to the test point corresponding to the voltage level selected for calibration.

4. On the voltmeter, observe the measured voltage value. Ideally, the value appearing in the **Value in Gen** (top right field) will match the reading on the voltmeter. If not, adjust the value in the **Measure #1** field up or down by pressing the key next to the up or down arrow, respectively, until the **Measure #1** field is set to the value displayed on the voltmeter (to within Calibration Accuracy ranges shown in Table 3-5). Each time the key is pressed changes the voltage value up/down in one-tenth volt increments.
5. Press key next to the **Save Calibrate** field to save the calibration entry.
6. Press the key next to **Previous Screen** to return to the A/D Calibration menu.

kV Calibration Function

This procedure calibrates the generator to verify accurate system measurement of peak tube potential (kVp). The generator's ability to measure peak tube potential accurately is verified using a pre-calibrated kVp meter (Dynalyzer or equivalent) as a benchmark. Access the KV Calibration Screen, shown below, and proceed as follows:

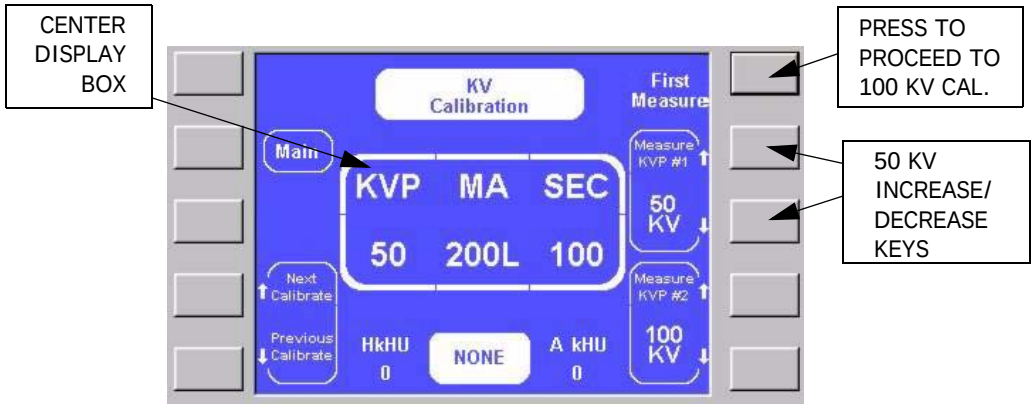


Figure 3-29. KV Calibration Screen (50 kV Calibration)

WARNING! To avoid injury to personnel, ensure that system power is removed prior to making and removing any electrical connections.

1. Connect a kVp bleeder tank in series between X-ray tube and the generator's H.V. Transformer (A17), or use a non-invasive kVp meter.
2. Verify **50 KVP** appears in the center display box of the KV Calibration Screen and **First Measure** appears in the top right field.
3. Take an exposure at the setting indicated in the center display box (i.e., 50 kVp, 200L mA, 100 mS).
4. On the kVp meter, observe the measured kV value. (Ideally, this value should be 50 kVp.)
5. If not 50 kVp, adjust the value in the **Measure KVP#1** field up or down by pressing the key next to the up or down arrow, respectively, until the **Measure KVP#1** field is set to the value displayed on the kVp meter. Each time the key is pressed changes the kV value up/down in one-tenth increments.

6. Press key next to the **First Measure** field to proceed to 100 kV calibration setting. The following screen should be displayed:

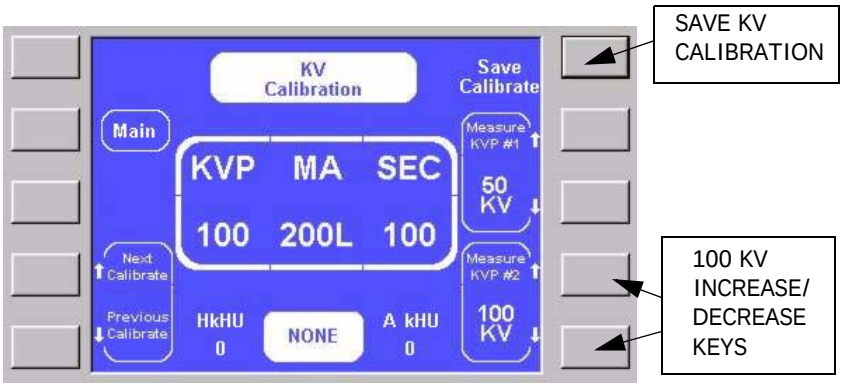


Figure 3-30. KV Calibration Screen (100 kV Calibration)

7. Verify **100 KVP** appears in the center display box and **Measure, Calibrate** appears in the top right field.
8. Take an exposure at the setting indicated in the center display box (i.e., 100 kVp, 200L mA, 100 mS).
9. On the kVp meter, observe the measured kV value. (Ideally, this value should be 100 kVp.)
10. If not 100 kVp, adjust value in **Measure KVP#2** field up or down by pressing the key next to the up or down arrow, respectively, until **Measure KVP#2** field is set to value displayed on kVp meter. Each time the key is pressed changes the KV value up/down in one-tenth increments.
11. Press key next to the **Save Calibrate** field to save the 50 and 100 kV calibration entries. The KV Calibration Screen (First Measure) should be displayed.
12. To proceed to filament calibration, press the key next to the **Next Calibration** field.

Filament Offset Calibration

This procedure establishes the filament current offset and gain corrections. Filament current measurement accuracy is verified using a pre-calibrated Dynalyzer (or equivalent), non-invasive kV meter, or mAs meter as a benchmark. Ensure precision of the measurement instrument is sufficient enough to assure generator accuracy requirements can be met. The Filament Offset Calibration procedure may be performed using an oscilloscope, however, it is not the preferred method. Using this method, the objective is to achieve the "flattest" possible large and small filament waveforms, with no spikes or peaks as shown in Figure 3-31 below.

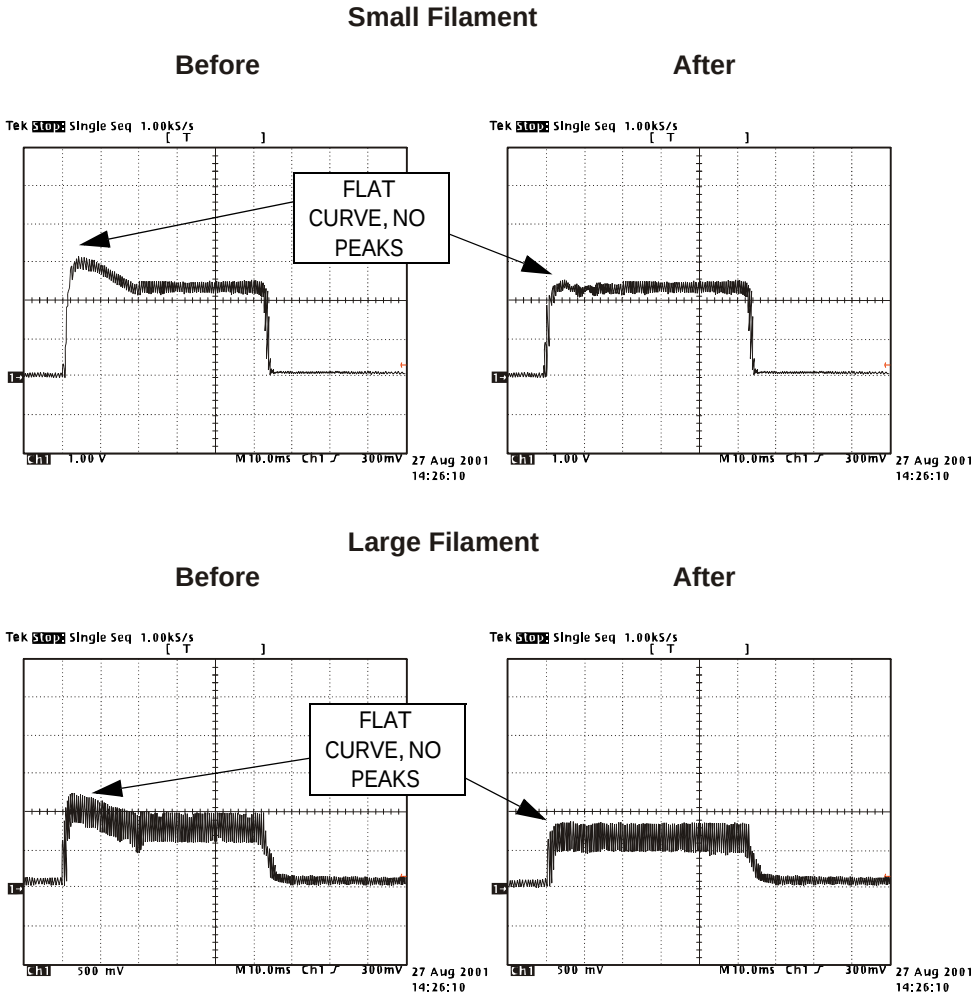


Figure 3-31. Filament Offset Current Measurement (Using an Oscilloscope)

Access the Filament Calibration Menu (shown in Figure 3-31) and proceed as follows:

WARNING! To avoid injury to personnel, ensure system power is removed prior to making and removing any electrical connections.

1. If using a Dynalyzer, a kVp bleeder tank should be connected in series between tube and High-Voltage (H.V.) Transformer A17.
2. If using a mAs meter, remove two (2) green/yellow wires marked "MAS METER", connected to A17P1-9 and A17P1-10, from the ground stud on top of the H.V. Transformer (see Figure 3-32). Connect the mAs meter in series between removed wires. The MAS meter should remain connected throughout calibration. (*Important: These wires must be re-connected when finished calibration.*)

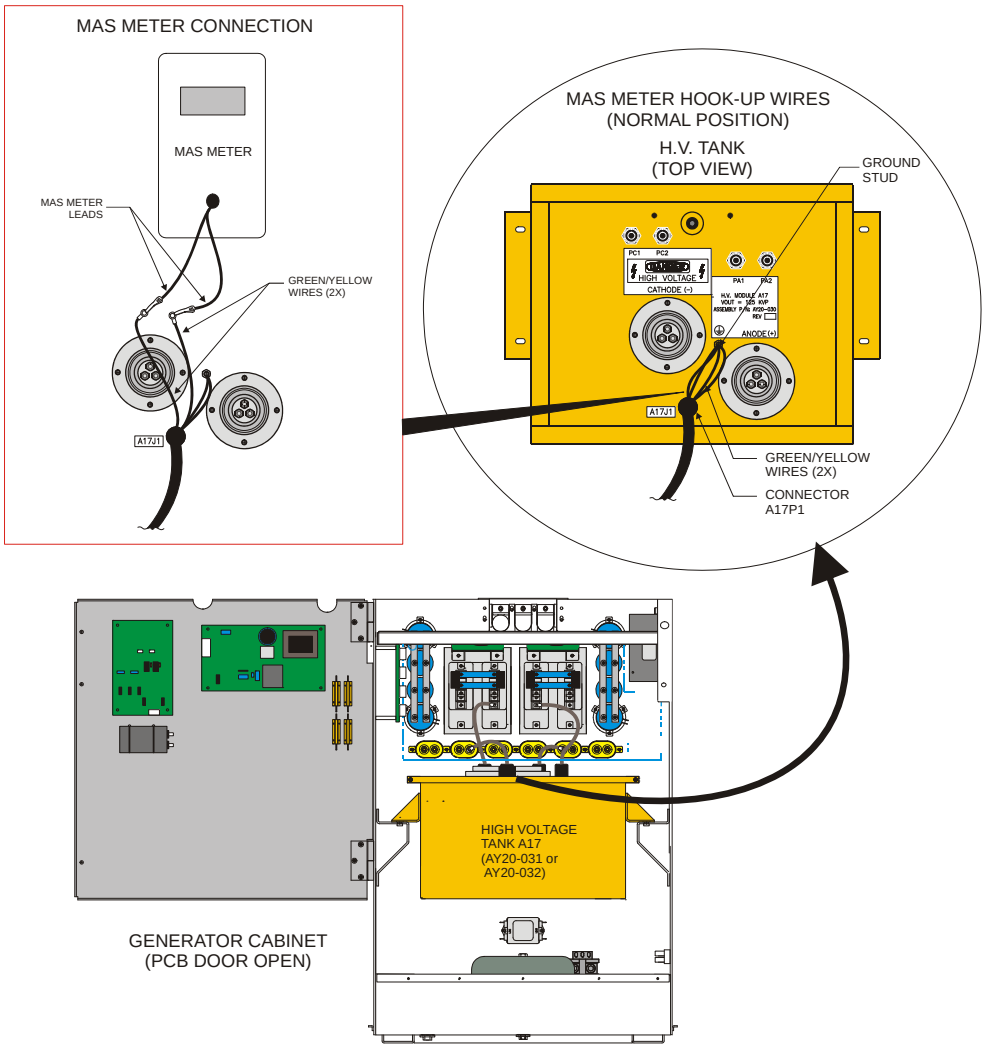


Figure 3-32. MAS Meter Connection

3. If using an oscilloscope, connect the scope leads between test point TP7 on KVP Control Board A2 (AY40-003S) and ground. Set scope for 1.0 volt/division, and 50 ms/division time base. This will give a 100 mA/volt equivalent for filament current measurement as shown in the sample waveforms in Figure 3-31.

4. Access the Small Filament Calibration Screen:

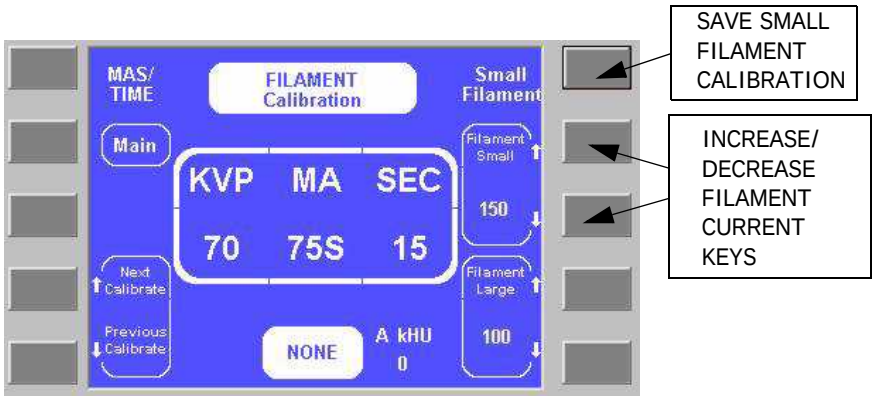


Figure 3-33. Filament Calibration Screen (Small Filament)

5. Take an exposure at the setting indicated in the center display box of the Filament Calibration Screen (i.e., 70 kVp, 75S mA, 15 msec). *If using an oscilloscope, set time to 50 msec*.

6. On the Dynalyzer Digital Display or mAs meter, observe the measured current value. (Ideally, this value should be 75 mA or 1.125 mAs.) If using an oscilloscope, observe the small filament current pulse waveform for "flatness" (see Figure 3-31).

7. If not 75 mA, or if waveform is not flat, (adjust the small filament offset value in the **Small Filament** field up or down (pressing up arrow increases mAs, pressing down arrow decreases mAs). Note: The DAC value displayed in the field adjacent to the up/down arrows increases as the mAs value decreases, and decreases as the mAs value increases. Retake exposure at same settings and adjust small filament offset value if necessary. Repeat this step until measured mA is 75, or until waveform is relatively flat.

8. When measured mA is 75, or when waveform is sufficiently flat, press the key next to the **Small Filament** field. The large filament calibration screen is displayed:

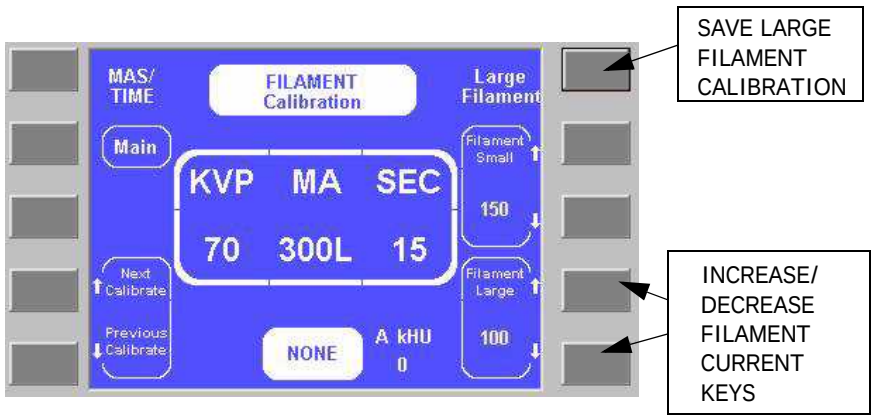


Figure 3-34. Filament Calibration Screen (Large Filament)

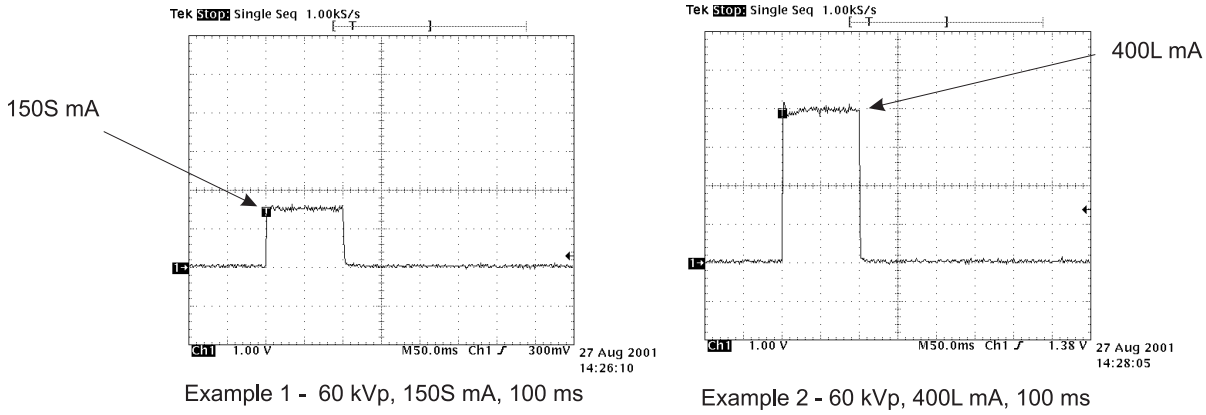
9. Take an exposure at the setting indicated in the center display box of the Filament Calibration Screen (i.e., 70 kVp, 300L mA, 15 msec). *If using an oscilloscope, set time to 50 msec*.
10. On the Dynalyzer Digital Display or mAs meter, observe the measured current value. (Ideally, this value should be 300 mA or 4.5 mAs.)
11. If not 300 mA, or if waveform is not flat, adjust the large filament offset value in the **Large Filament** field up or down (up increases mA, down decreases mA).
12. Re-take exposure at same settings and adjust large filament offset value if necessary. Repeat this step until measured mA is 300, or until waveform is relatively flat.
13. When measured mA is 300, filament calibration is complete.
14. To proceed to mA calibration, press the key next to the **Next Calibration** field.

Note: An error message appears if the filament current is set too low, which indicates the filament offset value for the filament being calibrated is set too high. If this occurs, increase the filament current by lowering the filament offset value (i.e., by pressing the Filament Small or Filament Large up arrow key).

MA Calibration

This procedure calibrates the generator to verify accurate system measurement of tube current (mA). Current measurement accuracy is verified using a pre-calibrated mAs meter (Dynalyzer or equivalent) as a benchmark. Ensure precision of the measurement instrument is sufficient enough to assure generator accuracy requirements can be met.

An oscilloscope may be used for mA measurement, however, it will likely not be precise enough to assure generator mA accuracy. To use an oscilloscope for mA measurement, connect scope leads between test point TP7 on KVP Control Board A2 (AY40-003S1) and ground. Set scope for 1.0 volt/division, and 50 ms/division time base. This will give a 100 mA/volt equivalent for mA measurement (see Figure 3-35a for sample mA measurements using scope).



Example 1 - 60 kVp, 150S mA, 100 ms

Example 2 - 60 kVp, 400L mA, 100 ms

Figure 3-35a. Filament Offset Current Measurement Using an Oscilloscope

Proceed as follows:

WARNING! To avoid injury to personnel, ensure system power is removed prior to making and removing any electrical connections.

1. If not already done so, connect a kVp bleeder tank in series between tube and High-Voltage (H.V.) Transformer A17. If using a mAs meter, connect the mAs meter leads between pins A17P1-9 and A17P1-10 on H.V. Transformer A17. This connection is made by removing the two green/yellow wires connecting A17P1-9 and A17P1-10 to the ground stud on top of the H.V. Transformer (see Figure 3-21) and connecting the removed wires to the mAs meter. *(Note: The MAS meter should remain connected throughout calibration. These wires must be re-connected when finished calibration.)*

2. Verify **75S MA** appears in the center display box of the MA Calibration menu and **First Measure** appears in the top right field.

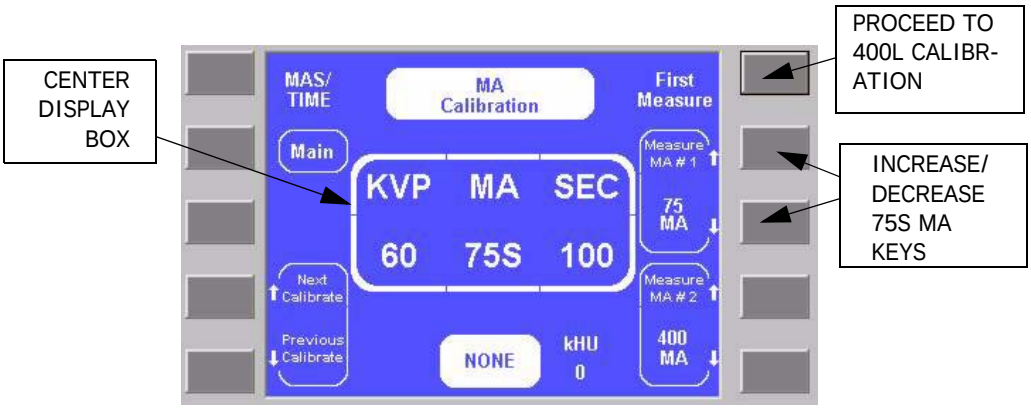


Figure 3-35. MA Calibration Screen (First Measure)

3. Take an exposure at the setting indicated in the center display box (i.e., 60 kVp, 75S mA, 100 mS).
4. On the Dynalyzer Digital Display or on mAs meter, observe the measured mA value. (Ideally, this value should be 75 or 7.5 mAs.)
5. If not 75 mA, adjust the value in the **Measure MA#1** field up or down by pressing the key next to the up or down arrow, respectively, until the **Measure MA#1** field is set to the value displayed on the mAs meter. Each time the key is pressed changes the MA value up/down in one-tenth increments.
6. Press key next to the **First Measure** field to proceed to 400L mA calibration setting. The following menu should be displayed:

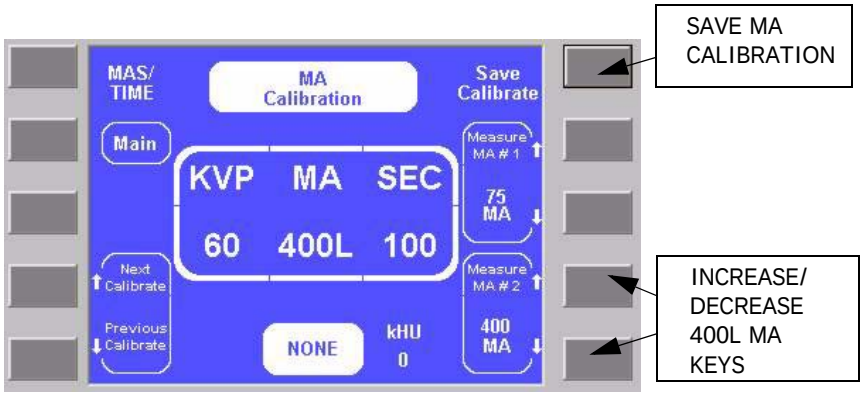


Figure 3-36. MA Calibration Menu (Second Measure)

7. Verify **400L MA** appears in the center display box and **Measure, Calibrate** appears in the top right field.
8. Take an exposure at the setting indicated in the center display box (i.e., 60 kVp, 400L mA, 100.0 mS).
9. On the Dynalyzer Digital Display or on mAs meter, observe the measured mA value. (Ideally, this value should be 400 mA or 40 mAs.)
10. If not 400 mA, adjust the value in the **Measure MA#2** field up or down by pressing the key next to the up or down arrow, respectively, until the **Measure MA#2** field is set to the value displayed on the kVp meter. Each time the key is pressed changes the MA value up/down in one-tenth increments.
11. Press key next to the **Save Calibrate** field to save the 75S and 400L mA calibration entries. The MA Calibration Menu (First Measure) should be displayed.
12. Take 60 kVp, 75S mA, 100 ms and 60 kVp, 400L mA, 100 ms exposures. The measured kVp values should correspond with the indicated kVp settings within 3% tolerance; and the measured mA values should correspond with the indicated mA settings at least within 4%+1 mA. If not, repeat kVp and/or mA calibration as described in the previous paragraphs.

    Note: The Power Supply Board's +48 VDC output may require adjusting (using potentiometer A6R17) up to +55 VDC (max.) in cases where long-length high tension cables are used and/or a heavy duty x-ray tube is installed. This can be determined by measuring the mA output (using a Dynalyzer or mAs meter), of an exposure taken at 40 - 50 kVp and the highest mA station available. The mA measured should be the same as the indicated mA (within specified tolerance). If mA output is too low, increase the +48 VDC voltage output as required, but do not exceed +55 VDC.

13. If the system is equipped with QG-AEC option, perform AEC Calibration procedures. Otherwise, calibration is complete. To return to the Service Calibration screen, press the key next to the **Main** field.

CAUTION! If using a mAs meter, re-connect the green/yellow wire marked "MAS METER" to the ground stud on top of the H.V. Transformer (see Figure 3-32).

AEC CALIBRATION

IMPORTANT! Before performing each AEC calibration procedure, verify the correct Film/Screen is displayed on the calibration screen (shown in top left field). The Film/Screen setting is selected in the AEC Calibration Menu.

Refer to Appendix A for instructions on AEC calibration of systems using a digital receptor (DR) or a computed radiographic (CR) film plate.

The following calibration procedures must be performed on systems equipped with QG-AEC option (automatic exposure control). Each film/screen combination used with the system requires calibration for AEC in order to ensure that when a given film/screen combination is selected by the user, it produces films having a preset optical density, referred to as the "base optical density".

The HF Series X-ray generator provides for calibration of up to seven different film/screen combinations (eight including "Digital" on systems with digital receptor enabled). Each of the image receptors used with the system can be configured to use a particular film/screen combination using the Service Settings Menu (see Figure 3-16). (Refer to SYSTEM SETTINGS paragraph in this chapter for instructions on system settings.) For example, when the operator presses the WALL key on the operator control panel and selects the WALL 72" receptor, the system can be programmed to use the "Wall 72"" designated film/screen combination (i.e., the film/screen type used with the wall stand at 72" SID). On the same system, a different film/screen type, designated as "Table 40" for example, could be configured for use with the TABLE receptor.

Typically, on a system using a wall stand and radiographic table, three separate film/screen combinations are used:

- Wall 72" - Used when the operator selects wall receptor at 72 inch source-to-image distance (SID)
- Wall 40" - Used when the operator selects wall receptor at 40 inch source-to-image distance (SID)
- Table 40" - Used when the operator selects table receptor at 40 inch source-to-image distance (SID)

On generators equipped with "Universal" type AEC (AEC Board A11 AY40-027S installed), two additional image receptors and their corresponding film/screens (default names are "WALL2" and "AUXILLIARY") can also be configured similar to those listed above. It is important to note that each different type of film/screen combination used with the receptors be calibrated in accordance with the AEC Calibration procedures described in this chapter.

The design of the HF Series x-ray generator assumes that a limited number of films and screens are used in a facility (up to seven). Whether or not AEC is used, the *only* method of specifying film speed is in the AEC Calibration Menu (see Figure 3-40). With seven available film/screens, the operator should have a sufficient selection of film/screen options for use with the system.

NOTE

The factory default Wall 72", Wall 40" and Table 40" film/screen combination names can be changed, if desired, using the **Edit F/S Name** utility provided on the AEC Calibration Menu. This applies to the factory default "100 Speed", "200 Speed", "800 Speed", and "Film/Screen 7" film/screen combination names as well.

The AEC Calibration Menu

To access the AEC Calibration function, press the key next to the **AEC Calibration** field in the Service Calibration Menu (see Figure 3-24). The AEC Calibration menu displays:

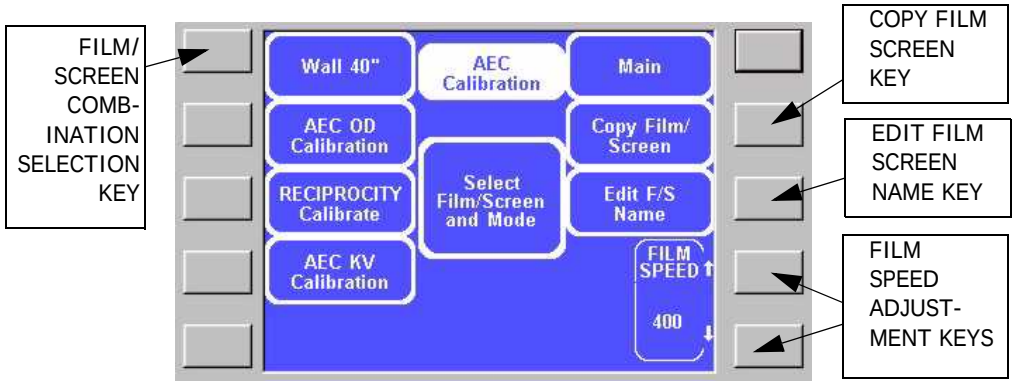


Figure 3-37. AEC Calibration Menu

NOTE: In normal AEC mode, select the appropriate receptor (Wall 72", Wall 40", or Table 40") prior to selection of a film/screen combination for AEC calibration.

The AEC Calibration menu provides access to the system's various AEC calibration functions, briefly described as follows:

- **Film Screen/Combination Selection Key** - Selects the film/screen combination you want to calibrate (system default choices are Wall 72", Wall 40", Table 40", 100 Speed, 200 Speed, 800 Speed, Film/Screen 7, and DIGITAL (if "Digital Receptor" is enabled in the Service Configuration Menu)
- **AEC OD Calibration** - Calibrates the optical density for the currently selected film/screen and ion chamber combination
- **Reciprocity Calibration** - Calibrates the reciprocity failure law correction factor for the currently selected film/screen and ion chamber combination
- **AEC KV Calibration** - Calibrates the tube voltage settings used in conjunction with the currently selected film/screen and ion chamber combination
- **Main** - Returns to the Service Calibration Menu (see Figure 3-27)
- **Copy Film/Screen** - Accesses the Copy Film/Screen Menu. The Copy Film/Screen Menu is a utility that enables AEC calibration data to be copied from one calibrated film/screen combination

setting to another (for example, it is useful for copying "Wall 40" to "Table 40 " film/screen combination on systems configured with both a wall stand and table).

- **Edit F/S Name** - Provides editing utilities for modifying the name of a film/screen combination
- **FILM SPEED** - Selects the film speed of the currently selected film screen combination. True speed may be set from "50" to "1600" in increments of 10.

AEC Calibration Procedures

Calibration of film/screen combinations should be performed in the following sequence, assuming a typical radiographic system having one ion chamber in the wall stand (72" and 40" SID), and a second ion chamber used in a radiographic table (40" SID).

If the system is using a wall stand and 200 and 400 speed films, calibrate the Wall 72" film screen combination using 200 speed film first, followed by Wall 72" using 400 speed film.

If the system only has a table receptor, perform all AEC calibrations (i.e., ion chamber balance, AEC MAS balance, AEC optical density, Reciprocity, and AEC KVP procedures). If the generator is interfaced with a digital receptor (DR system) or computed radiography system (CR System), refer to Appendix A, AEC CALIBRATION WITH DIGITAL RECEPTOR OR CR FILM PLATE for AEC calibration procedures.

IMPORTANT NOTE: Typically, the AEC calibration parameters for each of the various receptors used with the generator are quite similar. Therefore, the HF Series generator's calibration data "COPY" function can be used to copy the calibration parameters from one receptor (i.e., a calibrated receptor) to the other receptors. For example, after completing AEC calibration of 72" Wall film/screen, the "COPY" function can be used to copy the 72" film/screen calibration data to 40" Wall film/screen.

After copying AEC data, the only further AEC calibration usually required for the 40" film/screen is performing AEC OD Calibration to set the "AEC Ref" value. Similarly, the 40" Wall film/screen calibration data can be copied to the 40" Table, however, the table ion chamber's MASTER GAIN potentiometer must be adjusted as required. Be sure to verify the AEC films for each SID/receptor meet applicable regulatory agency requirements. If required, further optical density accuracy can be attained by performing the "AEC KV Calibration" procedure.

NOTE

The film speed setting affects the mAs setting used with *non-AEC* APR techniques. With the film speed set for 400, for example, assume an APR technique is programmed to use 10 mAs. If the film speed is changed to 100, the system automatically adjusts the same APR technique to now use 40 mAs (4 x 10 mAs = 40 mAs).

AEC Ion Chamber Balancing (Three-field Chambers)

On systems using a three-field ion chamber, the chamber detectors must be balanced prior to performing AEC calibration (refer to the ion chamber manufacturer's instruction manual). When balanced, the mAs will be approximately the same (±5%) for exposures taken using any of the three chambers, or with two or more chambers selected simultaneously. This procedure must be performed on each ion chamber used in the system (for example, both table and wall ion chambers when equipped with two). Before proceeding, check that the ion chamber detectors have been correctly configured so when the chamber select keys on the operator control panel are pressed, the appropriate ion chamber detector is enabled. If not, refer to "Table/Wall Ion Chamber Configuration Screens" procedure described previously in this chapter and re-configure. Proceed as follows:

1. If not already done so, a kVp bleeder tank should be connected in series between tube and High-Voltage (H.V.) Transformer A17. If using a mAs meter, connect the mAs meter between pins A17P1-9 and A17P1-10 on H.V. Transformer A17.
2. Access Service Settings Menu (see Figure 3-16) and select **Back Up Time/MAS**.
3. In AEC Backup Setting screen (see Figure 3-22), make a note of the Backup mAs setting, then change the **Backup MAS** to "40".
4. Press the AEC Mode key on the operator control panel to enter AEC mode.
5. Using a lead sheet, cover the UPPER RIGHT and CENTER ion chamber detectors.
6. Place 20 CM acrylic over UPPER LEFT ion chamber detector.
7. Set OCP for 100 KV, 200L MA, select the UPPER LEFT ion chamber detector and take an exposure. Note the measured mAs reading.
8. Repeat above steps with the CENTER ion chamber detector selected and UPPER LEFT and UPPER RIGHT detectors covered with lead. The measured mAs reading should be within 5% of the mAs reading noted in the previous step. If not, adjust the CENTER detector gain potentiometer located on the ion chamber amplifier (refer to ion chamber manufacturer's documentation for details), re-take exposure and verify it is within tolerance. Repeat as necessary.
9. Access the Service Settings Menu and reset Backup mAs to original setting noted previously.

NOTE: If the system is equipped with "universal" type AEC (i.e., AEC Board A11 is part number AY40-027S), and the ion chamber is "level" type (i.e., Siemens), adjust the appropriate detector gain potentiometer on AY40-027S in accordance with the table below:

Table 3-6. Universal AEC Board A11 Detector Gain Adjustment Potentiometers (Siemens Ion Chamber Only)

ION CHAMBER	DETECTOR	AEC BOARD A11 (AY40-027S) POTENTIOMETER
TABLE	1	R61
TABLE	2	R63
TABLE	3	R66
WALL#1	1	R54
WALL#1	2	R55
WALL#1	3	R56
WALL#2	1	R53
WALL#2	2	R58
WALL#2	3	R57

10. Repeat above steps with UPPER RIGHT ion chamber detector selected and UPPER LEFT and UPPER CENTER detectors covered with lead. The measured mAs reading should be within 5% of the mAs reading noted in the previous step. If not, adjust the UPPER RIGHT detector gain potentiometer, re-take exposure and verify it is within tolerance. Repeat as necessary.
11. Access Service Settings Menu and select **Back Up Time / MAS**. Return the AEC Backup Setting to desired back up mAs.

NOTE

To avoid reciprocity compensation, the exposures for mAs balance verification ideally should not exceed 100 ms.

AEC MAS Balance Verification

The generator AEC mAs balance was pre-calibrated at the factory. However, verification of AEC mAs balance assures AEC calibration accuracy. When balanced, the mAs at the specified exposures will be approximately the same (±6%). This procedure only needs to be performed once prior to AEC calibration of the film/screen combination(s) used with the system. Proceed as follows:

1. If not already done so, connect a kVp bleeder tank in series between tube and High-Voltage (H.V.) Transformer A17. If using a mAs meter, connect the mAs meter between pins A17P1-9 and A17P1-10 on H.V. Transformer A17. This connection is made by removing the two green/yellow wires connecting A17P1-9 and A17P1-10 to the ground stud on top of the H.V. Transformer (see Figure 3-32) and connecting the removed wires to the mAs meter. (Note: These wires must be reconnected when finished calibration.)
2. Place 20 cm of acrylic in the X-ray beam. (Where practical, adjust acrylic thickness to obtain approximately 100 millisecond exposures.)
3. If calibrating a" level" type ion chamber, ensure all three ion chamber detectors are selected.
4. Press the AEC mode key on the operator control panel.
5. Set the operator control panel for 110 kVp (100 kVp if calibrating a "level" type (Siemens) ion chamber - requires AY40-027S AEC board), 75S mA and take an exposure.
6. On the Dynalyzer Digital Display or mAs meter, note the measured mAs value.
7. Set the operator control panel for 110 kVp (100 kVp if calibrating a "level" type (Siemens) ion chamber - requires AY40-027S AEC board) and the highest available mA station. Take an exposure.
8. On the Dynalyzer Digital Display or mAs meter, note the measured mAs value.
9. The mAs values noted must be within ±5%. If not, adjustment of the dV/dt potentiometer on AEC Board A11 is necessary:
   - If the generator is equipped with "standard" type AEC (i.e., AEC Board A11 is part number AY40-031S), adjust potentiometer A11R12 to increase or decrease the mAs value.

- If the generator is equipped with "universal" type AEC (i.e., AEC Board A11 is part number AY40-027S), and the ion chamber is "level" type (i.e., Siemens) , adjust potentiometer A11R82 to increase or decrease the mAs value.
- If the generator is equipped with "universal" type AEC (i.e., AEC Board A11 is part number AY40-027S), and the ion chamber is "slope" type (i.e., AID), adjust potentiometer A11R87 to increase or decrease the mAs value.

10. Re-take exposure at the above settings. Repeat until the two measured values are within range.
11. Take an exposure at 110 kVp (100 kVp if calibrating a "level" type (Siemens) ion chamber), 75S mA, 10 cm. Verify mAs value is within ±5% of previous measurements.
12. Take an exposure at 110 kVp (100 kVp if calibrating a "level" type (Siemens) ion chamber), a mid-range mA value, 10 cm. Verify mAs value is within ±5% of previous measurements.

CAUTION! If using a mAs meter, re-connect the green/yellow wire marked "MAS METER" to the ground stud on top of the H.V. Transformer (see Figure 3-32).

Editing a Film/Screen Combination Name

The system default Film/Screen Combination names are: Wall 72", Wall 40", Table 40", 100 Speed, 200 Speed, 800 Speed, Film/Screen7, and DIGITAL (if "Digital Receptor" is enabled in the Service Configuration Menu). These names, however, can be changed to suit individual requirements. The following procedure describes the steps necessary to edit the name of a film/screen combination using the "Edit F/S Name" utility. Proceed as follows:

1. If not already done so, access the AEC Calibration Menu (see Figure 3-37).
2. Press the key next to the "Film/Screen" field (top left key) until the desired film/screen combination is displayed. The possible default selections are "Wall 72", "Wall 40"", "Table 40", "100 Speed", "200 Speed", "800 Speed", "Film 7", and "Digital" (if "Digital Receptor" is enabled in the Service Configuration Menu).

3. Press the key adjacent to the **Edit F/S Name** field. The film/screen name Edit Sentence screen appears:

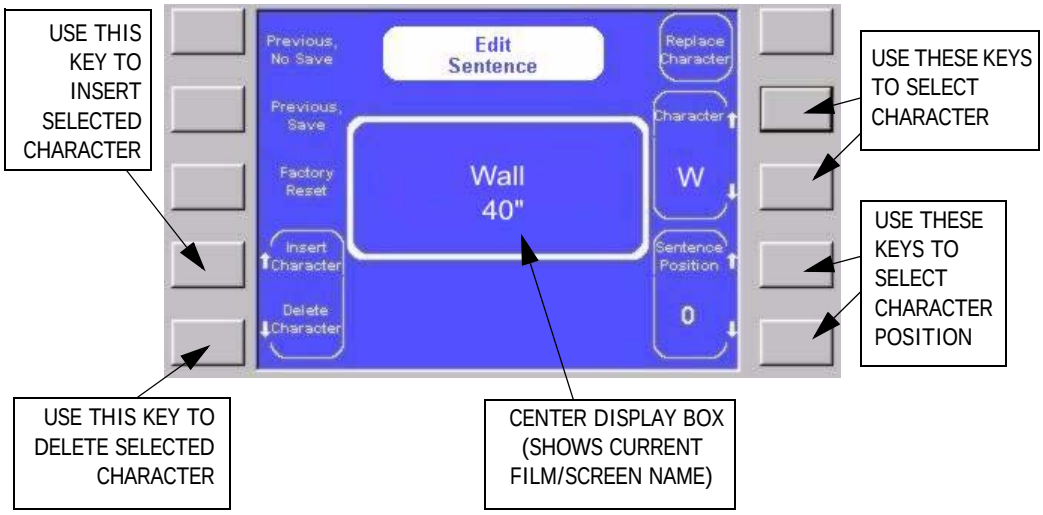


Figure 3-38. Sample Film/Screen Name Edit Sentence Screen

4. Use the up and down keys next to the **Sentence Position** field to select the location to insert, replace or delete a character. For example, if the text string "Wall 40" is displayed in the center display box as shown in the sample screen above, choosing character location "0" selects the letter "W", location "1" selects the letter "a", and so on. Note that the character in the selected location appears in the **Character** field.

5. To delete the selected character, press the key next to the **Delete Character** field. To insert a new character or to replace the selected character with a new character, use the up and down keys next to the **Character** field to scroll through all available alphanumeric characters (begins with a "no character" or blank space) until the character you want appears in the **Character** field window. To insert the selected character in the position chosen, press the key next to the **Insert Character** field. To replace the character in the selected location with the new character, press the key next to the **Replace Character** field.

6. When done editing the film/screen name, select **Previous, Save** to save the new settings and return to the AEC Calibration Menu or select **Previous, No Save** to ignore the changes and return to the AEC Calibration Menu. To restore film/screen name to the factory default name, press the key next to the **Factory Reset** field.

AEC Optical Density Calibration Procedure

This procedure calibrates the generator's AEC system to a user-selectable optical density setting (e.g., 1.3). When calibrating the first film/screen combination, which should be the slowest speed film and/or largest SID, set "AEC Ref" to 2000, and adjust the MASTER GAIN potentiometer on the ion chamber for desired optical density. Proceed as follows:

An AEC Calibration Worksheet is provided in Table 3-8 for recording calibration data.

Table 3-7. AEC Calibration Procedure Sequence

FILM/SCREENS TO BE CALIBRATED	REQUIRED AEC CALIBRATION PROCEDURES/SPECIAL INSTRUCTIONS
WALL STAND 72" SID FILM/SCREEN (SLOWEST SPEED, LARGEST SID)	1. Perform "Ion Chamber Balancing" procedure. 2. Perform "AEC MAS Balance" procedure for wall stand ion chamber. 3. Perform "AEC Optical Density (OD) Calibration": a. Set desired "base" optical density b. Set "AEC Ref" to 2000. c. Adjust ion chamber's MASTER GAIN potentiometer until base optical density is achieved in developed films. 4. Perform "Reciprocity Calibration". 5. Perform "AEC KV Calibration".
WALL STAND 40" SID FILM/SCREEN	1. Copy "Wall 72" film/screen to "Wall 40". 2. Perform "AEC Optical Density (OD) Calibration", however, **DO NOT** re-adjust the ion chamber MASTER GAIN potentiometer. Adjust "AEC Ref" to obtain desired (set) optical density. 3. Perform "Reciprocity Calibration". 4. Perform "AEC KV Calibration".
TABLE 40" SID FILM/SCREEN	1. If system includes a wall stand, copy "Wall 40" film/screen to "Table 40". 2. Perform "Ion Chamber Balancing" procedure for table ion chamber. 3. Perform "AEC Optical Density (OD) Calibration": a. Set desired "base" optical density b. Set "AEC Ref" to 2000. c. Adjust ion chamber's MASTER GAIN potentiometer until base optical density is achieved in developed films. 4. Perform "Reciprocity Calibration". 5. Perform "AEC KV Calibration".

Table 3-8. AEC Calibration Worksheet

Film/Screen Combination:	Table 40	Wall 40	Wall 72	Other1	Other2
AEC OD CALIBRATION					
Setting:	**50 kVp, 200L mA, 5 cm**				
Optical Density:					
AEC Ref.					
RECIPROCITY					
Setting:	**First Cal. - 50 kVp, 400L mA, 15 cm**				
Optical Density:					
Setting:	**Middle Cal. - 50 kVp, 75S mA, 15 cm**				
Optical Density:					
Setting:	**Save Cal. - 50 kVp, 25S mA, 15 cm**				
Optical Density:					
AEC KV CALIBRATION					
Setting:	**Step 1 - 50 kVp, 200L mA, 5 cm**				
Optical Density:					
Setting:	**Step 2 - 60 kVp, 200L mA, 10 cm**				
Optical Density:					
Setting:	**Step 3 - 80 kVp, 200L mA, 15 cm**				
Optical Density:					
Setting:	**Step 4 - 100 kVp, 200L mA, 20 cm**				
Optical Density:					
Setting:	**Step 5 - 110 kVp, 200L mA, 25 cm**				
Optical Density:					
Setting:	**Step 6 - 120 kVp, 200L mA, 30 cm**				
Optical Density:					
Setting:	***Step 7 - 130 kVp, 200L mA, 30 cm**				
Optical Density:					
Setting:	***Step 8 - 140 kVp, 200L mA, 30 cm**				
Optical Density:					

* Only required on 150 kVp systems

1. Place a film cassette in the tray and collimate down to film size.
2. If not already done so, access the AEC Calibration Menu (see Figure 3-37).
3. Press the key next to the **Film/Screen Combination** field (upper left field) to select a film/screen combination to calibrate. Verify the receptor in which the film cassette is inserted is selected as indicated on the AEC Calibration Menu screen.
4. The **FILM SPEED** field shows the current film speed setting for the selected film/screen combination. To select a different film speed, press the up or down keys next to the **FILM SPEED** field until the desired film speed setting is displayed.
5. When film/screen combination name and film speed settings are correct, press the key next to the **AEC OD Calibration** field to proceed with AEC Calibration. The AEC Optical Density Calibration Screen, shown below, is displayed:

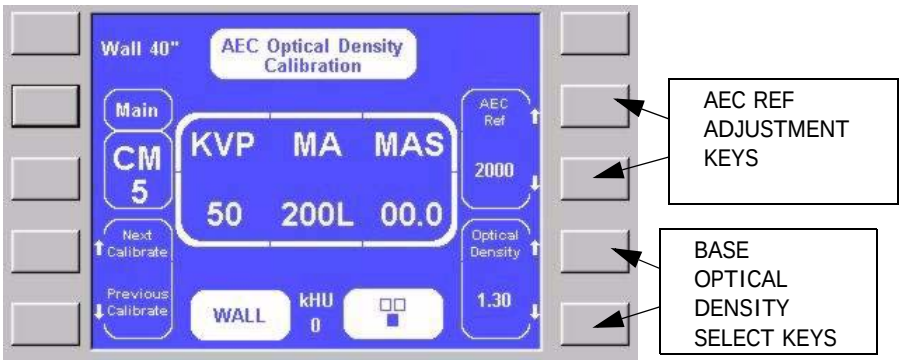


Figure 3-39. AEC Optical Density Calibration Screen

6. This screen is used to calibrate the selected film/screen combination to a user defined optical density setting (e.g., 1.30). Set the receptor and ion chamber detector selections to those that will be used with this film/screen combination and ensure x-ray tube is at correct SID. Ensure the ion chamber has been balanced.
7. Press the up or down key located next to the **Optical Density** field until the desired "base" optical density setting is displayed. (Note: The "base optical density" setting establishes the optical density of the films produced when the operator selects this film/screen combination in either APR AEC or AEC mode.)

8. If the selected film/screen combination is the first one to be calibrated with the system (if so, it should be combination having slowest speed and/or largest SID), perform the following steps:

   a. Verify the **AEC Ref** field is set to 2000. If not, use the up and down keys next to the **AEC Ref** field to set the AEC Ref value to "2000".

   b. If not already done so, set the **Optical Density** value to the desired film optical density value (for example, 1.30).

   c. Place 5 CM of acrylic in the X-ray beam. Take an exposure at the setting indicated in the center display box (i.e., 50 kVp, 200L mA).

   d. Develop film and measure optical density using a calibrated densitometer.

   e. If the system is equipped with AEC Board A11 part number AY40-031S, proceed as follows:

      i. If the measured optical density corresponds with base optical density setting, press the **Next Calibrate** key to save the setting and proceed to Reciprocity Calibration. If not, adjust potentiometer A11R22 (if calibrating the table receptor) or A11R23 (if calibrating the wall receptor), and repeat exposure. Continue until the measured optical density equals the base optical density setting (at least to within 5% of base optical density setting).

      ii. If the measured optical density still does not equal the Base Optical Density setting, set A11R22 or A11R23 to mid-range, then adjust the ion chamber's MASTER GAIN potentiometer until roughly the desired optical density of film is obtained. Further fine-tuning can then be achieved by adjusting potentiometer A11R22 (table) or A11R23 (wall) as described in the previous step.

   NOTE: If the measured optical density still does not equal the Base Optical Density setting even with the ion chamber's MASTER GAIN potentiometer set to maximum gain position, increase each chamber detector gain and perform the "AEC MAS Balance Verification" procedure. Repeat AEC Optical Density calibration. If the measured optical density still does not equal the Base Optical Density setting after adjusting the MASTER GAIN and gain of individual detectors, reduce the AEC Reference until you obtain the desired optical density.

   f. If the system is equipped with AEC Board A11 part number AY40-027S, proceed as follows:

i. If the measured optical density corresponds with base optical density setting, press the **Next Calibrate** key to save the setting and proceed to Reciprocity Calibration. If not, adjust potentiometer A11R77 (if calibrating the table receptor) or A11R79 (if calibrating the wall receptor), and repeat exposure. Continue until the measured optical density equals the base optical density setting (at least to within 5% of base optical density setting).

ii. If the measured optical density still does not equal the Base Optical Density setting, set A11R77 or A11R79 to mid-range, then adjust the ion chamber's MASTER GAIN potentiometer until roughly the desired optical density of film is obtained. Further fine-tuning can then be achieved by adjusting potentiometer A11R77 (table) or A11R79 (wall) as described in the previous step.

NOTE: If the measured optical density still does not equal the Base Optical Density setting even with the ion chamber's MASTER GAIN potentiometer set to maximum gain position, increase each chamber detector gain and perform the "AEC MAS Balance Verification" procedure. Repeat AEC Optical Density calibration. If the measured optical density still does not equal the Base Optical Density setting after adjusting the MASTER GAIN and gain of individual detectors, reduce the AEC Reference until you obtain the desired optical density.

9. If the selected film/screen combination is not the first one to be calibrated with the system, perform the following steps:

   a. Using the up and down keys next to the **Optical Density** field, set the optical density value to the desired film optical density value (for example, 1.30). This is referred to as the "base optical density" for this film/screen combination.

   b. Place 5 CM of acrylic in the X-ray beam. Take an exposure at the setting indicated in the center display box (i.e., 50 kVp, 200L mA).

   c. Develop film and measure optical density using a calibrated densitometer.

   d. If the measured optical density corresponds with base optical density setting, press the **Next Calibrate** key to save the setting and proceed to Reciprocity Calibration. If film density is too low, press the **AEC Ref** up arrow key and increase AEC Ref value, then repeat exposure. If density is too high, press the **AEC Ref** down arrow key and decrease AEC Ref value, then repeat expo-

NOTE

The series of AEC optical density measurements should be repeated as many times as required until optical density is sufficiently accurate to meet regulatory and facility requirements.

sure. Continue until the measured optical density equals the base optical density setting (at least to within 5% of base optical density setting).

10. Press the key next to the **Next Calibrate** field to advance to Reciprocity Calibration.

IMPORTANT! To ensure AEC optical density is correctly calibrated to the desired "base" optical density setting, either the AEC Ref value must be adjusted to obtain the desired base optical density (which is verified in the exposed film using a densitometer) or the Optical Density setting in the AEC Optical Density Calibration Menu must be set to the actual measured film density. For example, the calibrator would like the system AEC optical density setting to be "1.30". The calibrator must then adjust the "AEC Ref" value until the actual measured optical density of the film is 1.30. However, if the actual measured optical density is 1.29 and you decide not to continue to adjust the AEC Ref to achieve exactly 1.30 film optical density, then change the Optical Density setting in the AEC Optical Density Calibration Menu to "1.29". Note that 1.29 is now the "base" AEC optical density for the film/screen being calibrated.

Reciprocity Calibration Procedure

The Reciprocity Calibration Screen, shown below, is used to establish reciprocity failure compensation. The image receptor and chamber field settings remain the same as those used in the AEC Optical Density procedure.

This procedure requires three exposures; the first at approximately 100-200 milliseconds, the second at approximately one second and the third at approximately three seconds. The amount of acrylic specified in the following steps (i.e., 15 CM) should give appropriate exposure times for 40 inch SID, 400 speed film. However, the amount of acrylic may need to be adjusted for other film/screen combinations to compensate for differences in SID and/or film speed. For example, to calibrate at 72 inch SID, the amount of acrylic would be reduced to 10 CM.

NOTE

Reciprocity Calibration must be performed for each film/screen combination used with system.

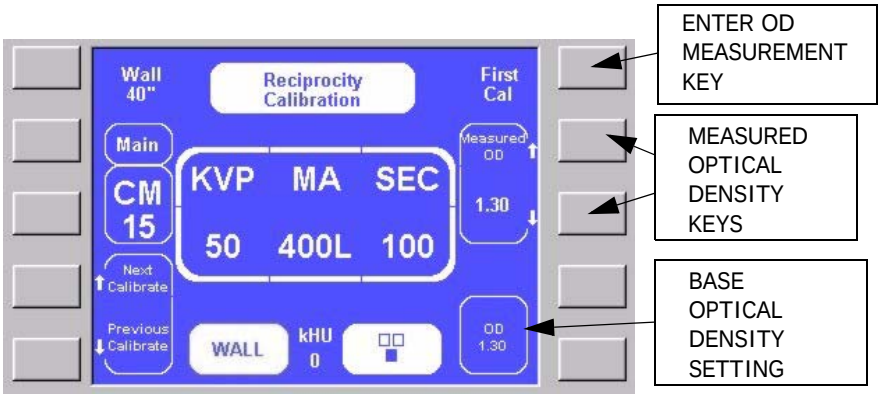


Figure 3-40. Reciprocity Calibration Screen

Proceed as follows:

1. Place a film cassette in the tray and collimate down to film size.
2. Place 15 cm of acrylic in the X-ray beam.
3. Verify the receptor in which the film cassette is inserted is selected as indicated on the AEC Reciprocity Calibration screen.
4. Take an exposure at the setting indicated in the center display box (i.e., 50 kVp, 400L mA).
5. Develop the film and measure the optical density using a calibrated densitometer.
6. Press the up or down key located next to the **Measured OD** field until the optical density value displayed equals the measured optical density value (the **Measured OD** up arrow key increases the optical density value and the **Measured OD** down arrow key decreases the optical density value).

7. Press the key next to the **First Cal** field to save the first (50 kVp, 400L mA) reciprocity calibration point entry. The Reciprocity Calibration screen is updated for the middle reciprocity calibration point.
8. Place a film cassette in the tray. Take an exposure at the setting indicated in the center display box (i.e., 50 kVp, 75S mA).
9. Press the up or down key located next to the **Measured OD** field until the optical density value displayed equals the measured optical density value.
10. Press the key next to the **Middle Cal** field to save the middle (50 kVp, 75S mA) reciprocity calibration point entry. The Reciprocity Calibration screen is updated for the final reciprocity calibration point.
11. Place a film cassette in the tray. Take an exposure at the setting indicated in the center display box (i.e., 50 kVp, 25S mA).
12. Press the up or down key located next to the **Measured OD** field until the optical density value displayed equals the measured optical density value.
13. Press the key next to the **Save Calibrate** field to save the calibration data for the 50 kVp, 25S mA reciprocity calibration point.
14. Press the key next to the **Next Calibrate** field.

AEC KV Calibration Procedure

The AEC KV Calibration screen, shown below, is used to calibrate the tube voltage to the "base optical density" setting. There are a total of six kV calibration points for a 125 kV system (50, 60, 80, 100, 110, and 120 kV); 150 kV systems require an additional two kV calibration points (130 and 140 kV). The image receptor and chamber field settings remain the same as those used in the Reciprocity Calibration procedure.

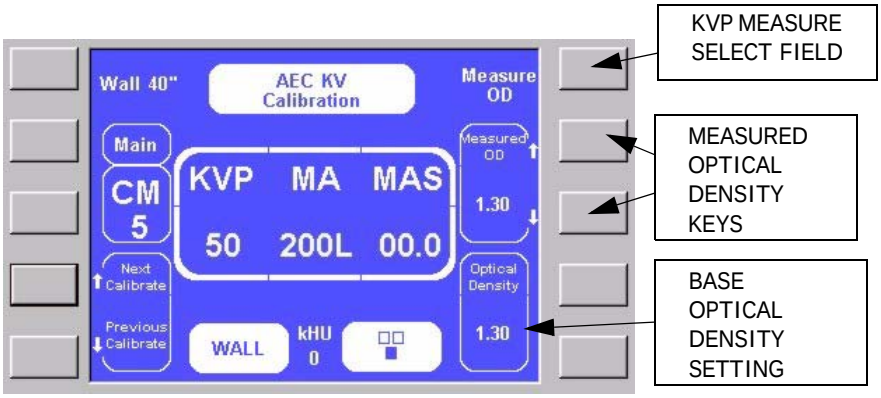


Figure 3-41. AEC KV Calibration Screen

Proceed as follows:

1. Place indicated thickness of acrylic (5 CM for first calibration point) in the X-ray beam.
2. Place a film cassette in the tray and collimate down to film size.
3. Verify the receptor in which the film cassette is inserted is selected as indicated on the AEC KV Calibration screen.
4. Take an exposure at the setting indicated in the center display box (i.e., 50 kVp, 200L mA).
5. Develop the film and measure the optical density using a calibrated densitometer.
6. Press the up or down key located next to the **Measured OD** field until the optical density value displayed equals the measured optical density value (the **Measured OD** up arrow key increases the optical density value and the **Measured OD** down arrow key decreases the optical density value). DO NOT TAKE ANY FURTHER EXPOSURES AT THIS SETTING.
7. Press the key next to the **Measure OD** field to save the first kV calibration point entry (50 kV, 5 CM). The AEC KV Calibration screen is updated for the next kV calibration point (60 kV, 10 CM).

NOTE

Calibration of the first step (50 kVp) is not required as long as AEC Optical Density Calibration procedure in the previous steps was performed prior to AEC KV Calibration. A verification that the "Measured OD" is the same as the "Optical Density" setting is all that is required.

NOTE

The series of AEC kV calibration exposures and optical density measurements may be repeated as many times as desired to improve calibration precision.

8. Repeat the previous steps for the 60, 80, 100, 110, 120, and, if 150 kV system, 130 and 140 kV calibration points, placing the specified thickness of acrylic in the x-ray beam as indicated on the AEC KV Calibration screen for each kV calibration point.
9. Upon completion of final kV calibration point (i.e., 120 kV on 125 kV systems, 140 kV on 150 kV systems), press key next to the **Measure OD** field. The field will now display **Save Calibrate**. Press this key again to save the calibration data for the final kV calibration point.

IMPORTANT! Data will be lost if Save Calibrate is not pressed!

10. Press the key next to the **Next Calibrate** field to return to the AEC Calibration menu (see Figure 3-37).
11. The series of six AEC KV calibration exposures (with optical density measurements) may be repeated as many times as desired to improve calibration accuracy. Repeating is recommended if the desired and measured optical densities differ significantly.
12. This completes AEC calibration for this particular film/screen combination. Repeat AEC calibration procedures for all additional film/screen combinations that will be used with the system.

Optical Density Accuracy Verification

Take several sample AEC films to verify optical density meets facility and/or applicable statutory or regulatory requirements (or at least within ±10% of desired (base) optical density). If not repeat AEC Optical Density and KV calibrations.

Copy Film/Screen Utility

On the AEC Calibration Menu (see Figure 3-37), an AEC calibration data copy utility is provided (**Copy Film/Screen** key). Following calibration of the first film/screen combination, stored AEC calibration data, such as the kV curves and AEC reference data, can be copied from the first film/screen combination to other film/screen combinations used with the system to reduce calibration time.

For example, if the preceding calibration was done for the wall stand 40 inch SID film/screen combination (i.e., Wall 40"), calibration data can be copied to the radiographic table's 40 inch SID film/screen combination (i.e., Table 40") using the Copy Film/Screen utility. Although all required AEC Calibration procedures must still be performed, this will set the calibration values for the Table 40" film/screen combination to fairly accurate settings, thereby reducing the number of exposures required for calibration. The Copy Film/Screen utility is most beneficial when the film screen combination being copied to has the same cassette screen, film speed, ion chamber and grid as the film/screen combination it is being copied from. Nevertheless, calibration is likely to be expedited even when one or more of these elements differ. Proceed as follows:

1. If not displayed, access the AEC Calibration Menu (see Figure 3-37).
2. Press the key next to the Film/Screen field (upper left field) until the the film/screen combination you want to copy calibration data to is displayed.
3. Press the key next to the **Copy Film/Screen** field.

4. The Copy/Film Screen screen appears:

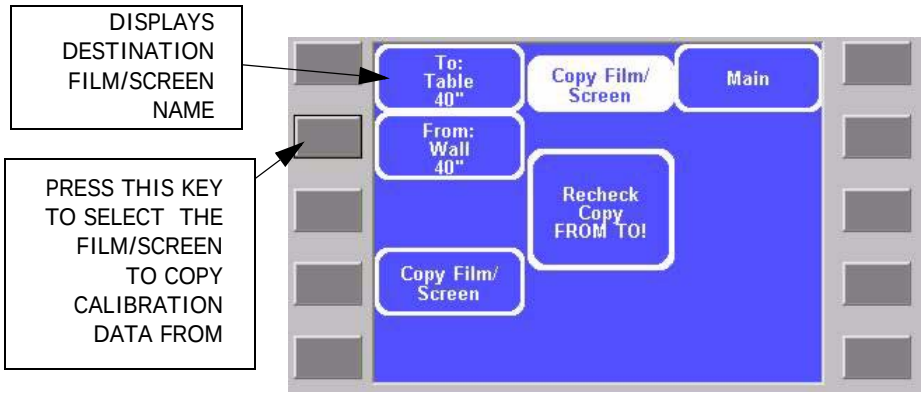

DISPLAYS DESTINATION FILM/SCREEN NAME
PRESS THIS KEY TO SELECT THE FILM/SCREEN TO COPY CALIBRATION DATA FROM
To: Table 40"
Copy Film/ Screen
Main
From: Wall 40"
Recheck Copy FROM TO!
Copy Film/ Screen

Figure 3-42. Copy Film/Screen Screen

5. Press the key next to the "**From**" field until the name of the film/screen combination from which calibration data will be copied appears.

CAUTION! Before proceeding, check to make sure the "from" and "to" film/screen copy selections are correct. Selecting Copy Film/Screen as directed in the next step causes existing calibration data for the film/screen being copied "to" to be overwritten with calibration data of the "from" film/screen.

6. Press the key next to the **Copy Film/Screen** field. All AEC calibration data is now copied from the Wall 40" film/screen combination to the Table 40" film/screen combination. To abort without copying, press the key next to the **MAIN** field. The AEC Calibration Menu is displayed.

IMPORTANT NOTES:

1. Upon completing calibration procedures, it is recommended that the Q-Ware program be used to upload calibration data (and APR technique data, if APR editing was performed) as a backup in case a problem occurs that requires re-calibration of the generator. To obtain a copy of the Q-Ware program, contact Quantum Medical Imaging's Customer Service Department.

2. Be sure to only use calibrated film/screens in all programmed APR procedures. If the APR default film screen is different than the calibrated film screen, the procedure must be edited to use the calibrated film screen.

NON-AEC REPRODUCIBILITY VERIFICATION

1. Set the Dynalyzer (or equivalent) for 75% trigger level on kVp. Ensure that the meter is set to measure mR.
2. Set the generator Operator Control Panel to Manual mode, 45 kV, 100 milliseconds exposure time, Normal Density.
3. Using Table 3-9 below, locate the model number of this generator and set the Operator Control Panel to the maximum mA setting shown in "SAMPLE 1 mA" column (large filament), then take 10 consecutive exposures recording the measured mR values in Non-AEC Reproducibility Data Sheet Table 3-10.

Table 3-9. Reproducibility Verification - mA Setting by Model

MODEL	SAMPLE 1 mA	SAMPLE 2 mA	MODEL	SAMPLE 1 mA	SAMPLE 2 mA
QG-20-SE	250	200	QG-40-2	500	400
QG-25	400	320	QG-40-3	500	400
QG-25-5	400	320	QG-40-SE	450	400
QG-32	500	400	QG-40-5	500	400
QG-32-2	500	400	QG-50	650	500
QG-32-3	500	400	QG-50-2	650	500
QG-32-SE	400	320	QG-50-SE	500	600
QG-32-5	500	400	QG-65	800	650
QG-40	500	400	QG-80	800	650

4. After the tenth exposure, select (coefficient of variation) **COEFF VAR** on Dynalyzer; reading must be less than or equal to 0.05. If a Dynalyzer is not used, calculate the C.O.V. (coefficient of variation) according to the following:

$$C = \frac{s}{\bar{X}} = \frac{1}{\bar{X}} \left[\sum_{i=1}^{n} \frac{(x_i - \bar{x})^2}{n - 1} \right]^{1/2}$$

Where

C= Coefficient of Variation
s = standard deviation
$\bar{x}$ = Mean value of mR readings
x_i = i^{th} observation sampled
n = number of observations sampled

AEC REPRODUCIBILITY VERIFICATION (ONLY PERFORM ON UNITS EQUIPPED WITH QG-AEC OPTION)

1. Set the Dynalyzer (or equivalent) for 75% trigger level on kVp. Ensure that the meter is set to measure mR.
2. Place 10 CM of acrylic in the X-ray field, and set the generator Operator Control Panel to AEC mode, 45 kV, Normal Density.
3. Using Table 3-9, locate the model number of this generator and set the Operator Control Panel to the maximum mA setting shown in "SAMPLE 1 mA" column (large filament), then take 10 consecutive exposures recording the measured mR values in AEC Reproducibility Data Sheet Table 3-11.
4. After the tenth exposure, select (coefficient of variation) **COEFF VAR** on Dynalyzer; reading must be less than or equal to 0.05. If a Dynalyzer is not used, calculate the C.O.V. (coefficient of variation) as above.

NON-AEC LINEARITY VERIFICATION

1. Set the Dynalyzer (or equivalent) for 75% trigger level on kVp. Ensure that the meter is set to measure mR.
2. Set the generator Operator Control Panel to Manual mode, 50 kV (60kV if 150kV, max output Generator), 100 milliseconds exposure time, Normal Density.
3. Using Table 3-9, locate the model number of the generator and set the Operator Control Panel to the mA setting shown in "SAMPLE 1 mA" column (large filament), then take 10 consecutive exposures recording the measured mR and mAs values in Non-AEC Linearity Data Table 3-12.
4. Set the Operator Control Panel to adjacent mA station (indicated in the "SAMPLE 2 mA" column of Table 3-9) and take 10 consecutive exposures recording measured mR and mAs values in Non-AEC Linearity Data Table 3-12.
5. Calculate the linearity using the worksheet provided in Table 3-12, and confirm it meets the required limit (< 0.1).

AEC LINEARITY VERIFICATION (ONLY PERFORM ON UNITS EQUIPPED WITH QG-AEC OPTION)

1. Set the Dynalyzer (or equivalent) for 75% trigger level on kVp. Ensure that the meter is set to measure mR.
2. Place 10 CM of acrylic in the X-ray field, and set the generator Operator Control Panel to AEC mode, 50 kV (60kV if 150kV, max output Generator), Normal Density.
3. Using Table 3-9, locate the model number of the generator and set the Operator Control Panel to the mA setting shown in "SAMPLE 1 mA" column (large filament), then take 10 consecutive exposures recording the measured mR and mAs values in AEC Linearity Data Table 3-13.
4. Set the Operator Control Panel to adjacent mA station (indicated in the "SAMPLE 2 mA" column of Table 3-9) and take 10 consecutive exposures recording the measured mR and mAs values in AEC Linearity Data Table 3-13.
5. Calculate the linearity using the worksheet provided in Table 3-13, and confirm it meets the required limit (<0.1).

NOTE
Time is measured at 75% of the peak kVp waveform. Exposure times must be greater than 100 milliseconds.

MAXIMUM DEVIATION: KVP, TIME, MA, MAS

1. Set the Dynalyzer (or equivalent) for 75% trigger level on kVp.
2. Refer to Table 3-14 and take exposures at the required settings and record the measured values in the data sheet.
3. Verify the following are within tolerance:

Accuracy Specifications		
kVp Accuracy:		kVp = ± (4.0% kV)
mA Accuracy:		mA = ± (5.0% mA + 1 mA)
Time Accuracy:	If: 1 msec. ≤ time ≤ 50 msec., If: 50 msec. < time ≤ 100 msec., If: 100 msec. < time ≤ 6300 msec.,	time = ± (2.0% time + 1 msec.) time = ± (1.0% time + 1 msec.) time = ± (0.5% time + 1 msec.)
mAs Accuracy:		mAs = ± (5.0% mAs + 0.5 mAs)

FACILITY: _____ ROOM#: _____
GENERATOR S/N: _____ TUBE MODEL:_____
ASSEMBLER: _____ TEST DATE:_____

Table 3-10. Non-AEC Reproducibility Data

Exposure Number	mR
1	
2	
3	
4	
5	
6	
7	
8	
9	
10	
MEAN VALUE ($\bar{x}$)	
C.O.V.	

Table 3-11. AEC Reproducibility Data

Exposure Number	mR
1	
2	
3	
4	
5	
6	
7	
8	
9	
10	
MEAN VALUE ($\bar{x}$)	
C.O.V.	

Table 3-12. Non-AEC Linearity Data

SAMPLE 1 mA (From Table 3-9)		= _____	SAMPLE 2 mA (From Table 3-9)		= _____
EXPOSURE	**mR**	**mAs**	**EXPOSURE**	**mR**	**mAs**
1			1		
2			2		
3			3		
4			4		
5			5		
6			6		
7			7		
8			8		
9			9		
10			10		
SUM			**SUM**		
MEAN VALUES = SUM ÷ 10			**MEAN VALUES = SUM ÷ 10**		
$\overline{X}_1 = \overline{mR} \div \overline{mAs}$	_____ ÷ _____		$\overline{X}_2 = \overline{mR} \div \overline{mAs}$	_____ ÷ _____	
$\overline{X}_1$	= _____		$\overline{X}_2$	= _____	
$\overline{X}_1 - \overline{X}_2$	= _____		$\overline{X}_1 + \overline{X}_2$	= _____	
LINEARITY =	= _____ must be ≤ 0.1				

Table 3-13. AEC Linearity Data

SAMPLE 1 mA (From Table 3-9)		= _____	SAMPLE 2 mA (From Table 3-9)		= _____
EXPOSURE	**mR**	**mAs**	**EXPOSURE**	**mR**	**mAs**
1			1		
2			2		
3			3		
4			4		
5			5		
6			6		
7			7		
8			8		
9			9		
10			10		
SUM			**SUM**		
MEAN VALUES = SUM ÷ 10			**MEAN VALUES = SUM ÷ 10**		
$\overline{X}_1 = \overline{mR} \div \overline{mAs}$	_____ ÷ _____		$\overline{X}_2 = \overline{mR} \div \overline{mAs}$	_____ ÷ _____	
$\overline{X}_1$	= _____		$\overline{X}_2$	= _____	
$\overline{X}_1 - \overline{X}_2$	= _____		$\overline{X}_1 + \overline{X}_2$	= _____	
LINEARITY =	**=** _____ **must be ≤ 0.1**				

Table 3-14. Maximum Deviation Data Sheet

		kVp	mA	Time**	mAs	Initials
1	SETTING	45	200L	50 mS	10	
	MEASURED					
2	SETTING	45	25S	5000 mS	125	
	MEASURED					
3	SETTING	60	200L	2000 mS	400	
	MEASURED					
4	SETTING	80	100L	3200 mS	320	
	MEASURED					
5	SETTING	100	200L	25 mS	5	
	MEASURED					
6	SETTING	100	75S	2000 mS	150	
	MEASURED					
7	SETTING	125	100L	100 mS	10	
	MEASURED					
8*	SETTING	140	500L	100 mS	50	
	MEASURED					

* Only required when generator is equipped with 150 kV option.
** If indicated time setting is not allowed based on installed tube, use highest time setting available.

IMPORTANT NOTE: Upon completing verification procedures, it is recommended that the Q-Ware program be used to upload calibration data and APR technique data (if APR editing was performed) to backup to your laptop the generator data in case a problem occurs that requires a factory reset and/or re-calibration of the generator. To obtain a copy of the Q-Ware program, contact Quantum Medical Imaging's Customer Service Department.

Chapter 4

THEORY OF OPERATION

OVERVIEW

The following paragraphs provide theory of operation for ODYSSEY HF Series™ Generators. Each circuit description references a functional block diagram contained in Chapter 6, Diagrams.

OPERATOR CONTROL PANEL CIRCUIT

NOTE: If the generator is configured with the "Q-Connect option" as in a Q-VISION equipped system, or if the generator is integrated to an external imaging system's workstation computer for operation as the generator's operator control panel - refer to Appendix B, CALIBRATION (Agfa DiRex) or Appendix D, CALIBRATION (Using Insight) for configuration and calibration instructions. The following circuit description does not apply to generators equipped with Q-Connect option.

The Operator Control Panel Circuit controls the X-ray generator's exposure settings and exposure sequence, and controls the display of settings on the Front Panel liquid crystal display (LCD). Exposure setting data is input to the Operator Control Panel Circuit through the Front Panel key switches. The READY, PREP, and EXPOSE LEDs located on the Front Panel are used to indicate the status of the exposure sequence. The Operator Control Panel Circuit includes an RS-232 service connection, which allows service personnel to download data to Flash Memory, perform X-ray generator diagnostics, and to upload non-volatile random-access memory (NVRAM) settings.

Microcontroller U3 Operation

Microcontroller U3 is the primary controller of Operator Control Panel Circuit functions. It has it own internal read-only memory (ROM) and random-access memory (RAM). The 32 MHZ output from Oscillator U18 provides the clocking input to drive Microcontroller U3. The Reset Circuit U1 monitors the +5 VDC supply voltage; when it falls below +4.5 VDC, Microcontroller U3 is placed in the "reset state". When the voltage returns to a level above 4.5 VDC, the Microcontroller restarts.

Data is sent to the generator via a 9-pin connector and cable connected to the generator Logic Board. The 9-pin cable includes RS-485 communication, hardware control lines, and power supply voltage from the generator. PREP and EXPOSE hardware lines are routed from Open Collector Driver U16 to the generator to indicate the state of the system to the generator.

Flash Memory U2

Flash Memory U2 holds part of the main program and all of the tables for the LCD display screens. Flash Memory is accessed by Microcontroller U3 through the DATA/ADDRESS bus and Control Signals. On the first memory

read/write clock cycle, the Flash Memory address is stored in Latches U4 and U5. On the second clock state, Microcontroller U3 reads or writes the data to Flash Memory U2.

The Flash Memory is programmable using a personal computer via the RS-232 port (connector J4).

EEPROM U17 Operation

Non-volatile random-access memory (EEPROM) U17 stores all data changes that occur during X-ray generator operation, and contains configuration settings, calibration data, and Anatomical Programmed Regions (APR) technique data. This data is retained even when power to the generator is shut down. NVRAM data is accessed in two steps:

- The memory address is stored in 8-Bit Latches U11 and U13.
- Microcontroller U3 reads or writes to EEPROM U17 by generation the appropriate Control Signals.

Note: In the event of a failure of OCP Microprocessor Board A16A1 (part number AY40-004S) resulting in the replacement of A16A1, remove EEPROM U17 from the old OCP Microprocessor Board and install it in the replacement OCP Microprocessor Board (U17 is socket-mounted). By doing so, all configuration and calibration settings and customized APR screens will be retained. In the unlikely event EEPROM U17 is damaged and must be replaced, the X-ray generator must be recalibrated, and the edited APR screens reentered.

LCD Controller U12 Operation

LCD Controller U12 controls the Odyssey HF Series LCD display (the LCD on Quest systems has the LCD Controller built in). The microcontroller U3 stores the data that will be displayed on the current screen in the RAM of LCD Controller U12. Microcontroller U3 sends the memory address of U12 it wants to access to 8-Bit Latches U11 and U13, then, through a handshake sequence, U3 writes or reads the data to/from U12 memory. LCD Controller U12 then processes the data stored in its RAM memory, and generates the appropriate signals to the LCD display to display the data stored by U3. Counter U19 provides the 16 MHZ and 8 MHZ inputs to LCD Controller U12.

The CFL Driver provides AC voltage required for the LCD's fluorescent backlighting through connector J7.

Buffer U23 and Latch U14 are used on Quest systems to send/receive data from the LCD.

Switching Power Supply Circuit

The Switching Power Supply circuit converts unregulated 28VDC to several regulated voltages that are required by the Operator Control Panel Circuit. Pulse-Width Modulator (PWM) U21 chops DC to AC. Transformer T1 steps down the AC voltage, which is then rectified and filtered. The regulated +5 VDC provides voltage for logic IC's in the Operator Control Panel Circuit. The voltage +3.3 VDC is required for operation of LCD Controller U12. +12 VDC is needed for the CFL Driver, and input to the coil of relay K1. Adjustable voltage -7 VDC to -24 VDC is needed for the LCD displays.

Potentiometer R17 adjusts the intensity of the LCD display. There is a different operating voltage range between the two LCD displays. The Odyssey LCD voltage range is -16V to -24V, and the Quest -8V to 16V. In order to set the Quest voltage range JP12 must be install.

Front Panel Key Activation Detection Circuit

The detection of a pressed key on the Front Panel of the Operator Control Panel is sensed by 8-Bit Driver U7 and 8-Bit Latch U8. 8-Bit Driver U7 scans the matrix arrangement of the key switches set by 8-Bit Latch U8. Microcontroller U3 controls the scanning timing of the key switches. The data sent for scanning and reading is transferred over the DATA/ADDRESS bus.

Jumpers Installation

The following jumpers must be installed for proper operation of the OCP: JP1, JP6, JP7, JP10, JP11, JP12 (only on Quest). If EXPOSE and PREP will be input through remote hand switch only (i.e., connected to TB1), then JP6 and JP7 should be removed. This prevents operation of the Expose and PREP Front Panel key switches.

TechVision Compatibility

To interface the generator with an optional "TechVision" supplementary operator control panel on Q-VISION equipped systems or integrated CR/DR imaging systems, the generator must be equipped with an optional OCP Interface Board AY40-073S ("Q-Connect option"). The Q-Connect option enables bi-directional Ethernet communication between Q-VISION OCP or the DR/CR system's computer workstation and the x-ray generator. In the case of an integration system, the exposure technique settings can be set either from the DR/CR workstation computer's screen, which functions as the generator's operator control panel, or from a TechVision operator control panel.

GENERATOR LOGIC CIRCUIT

The Logic Circuit controls the exposure sequence, based on settings and control signals received from the Operator Control Panel Circuit. In Standby, PREP, and Expose states, the Logic Circuit controls and monitors the Filament Regulator Control Circuit, KVP & Filament Control Circuit, Rotor board, Interface board, Line Monitor Circuit, and the AEC Circuit (when equipped).

Generator/OCP Communication

Communication with the Operator Control Panel Circuit is established via a 9-pin connector and cable connected between the OCP and generator cabinet. The 9-pin cable provides RS-485 serial communication, Operator Control Panel Circuit hardware control lines and power supply lines. There are two RS-232 service connections for connection to a personal computer for diagnostics, and for future interfacing with other systems.

Master and Slave Microcontroller Operation

Microcontroller U9 is the master microcontroller that controls the main functions of the generator, based on states and settings set at the Operator Control Panel. Microcontroller U9 has it own internal ROM and RAM. It is driven by a crystal oscillator at a clock speed of 32 MHz. Microcontroller U14 is configured as a slave microcontroller that controls the auxiliary functions of the generator, based on states and settings set by the master Microcontroller U9. Microcontroller U14 has it own internal ROM and RAM. It is driven by a crystal oscillator at a clock speed of 32 MHz.

There is a communication link between the master and slave for data and status exchange. The Reset Circuit U8 monitors the +5 VDC supply voltage; when it falls below +4.5 VDC, Microcontrollers U9 and U14 enter a reset state. When the +5 VDC supply voltage returns to a level above +4.5 VDC, the microcontrollers restart.

The master Microcontroller U9 has external Flash memory. The EPROM holds part of the main program. The EPROM is accessed by U9 through the DATA/ADDRESS bus of Microcontroller U9, with required Control Signals. On the first clock cycle, the Flash memory address is stored in Latches U12 and U13. On the second clock cycle, Microcontroller U9 reads data from Flash memory. Microcontroller U9 communicates with the KVP & Filament Control Circuit to set the digital-to-analog (D-A) converters and to read analog signals from analog-to-digital (A-D) converters.

In addition, there are hardware signals that control the Filament Regulator Control Circuit and KVP & Filament Control Circuit. Some of the key signals are isolated using opto-couplers. On systems utilizing the AEC option, the same connector (J1) is connected to the AEC board in parallel.

The interface board controls all external signals needed to interface to the tube stand, wall stand, and table. Some of the signals coming are isolated by opto-couplers. J2 interfaces to the line monitor board. The line monitor board supplies the 24VDC for the brakes. The line monitor supplies a sample of the 400 VDC bus for monitoring by Microcontroller U14, which uses an internal A-D converter to monitor key voltages including the +5V, 15V, 24V, 24V brake supply voltages. U16 is the 4.8V voltage reference for Microcontroller U14 internal A-D. Microcontroller U14 controls the Rotor Board; it provides the necessary signals for boost and run, and it monitors the tube rotation signal and rotor temperature.

FILAMENT CONTROL REGULATOR CIRCUIT

The Filament Control Regulator circuit is a high frequency, pulse-width-modulated-based system. The circuit receives signals from the KVP & Filament Control circuit and outputs filament current to the High-voltage Tank, which then produces the small or large filament currents for the X-ray tube. The detailed operation of the Filament Control Regulator circuit (see Filament Regulator Control Circuit Block Diagram in Chapter 6, DIAGRAMS) is as follows:

A signal from the KVP & Filament Control circuit that controls filament current is input to Filament Current Opto-isolator U2A. Varying the voltage of this signal will cause the output of U2A to vary between 0 and 5 volts. This varying voltage is fed to the input of Pulse Width Modulator U1. The output of the Pulse Width Modulator is input to Transformer Driver U3. The Transformer Driver buffers the output of the Pulse Width Modulator in order to supply enough current to drive Transformer T1. Transformer T1 drives an H-bridge circuit consisting of Q1-Q4. The output of the H-bridge is a 20 kHz signal that is output through Filament Select K1 and Q5 to drive the filament transformer in the High-voltage Tank. The duty cycle of the 20 kHz signal is varied by the Pulse Width Modulator depending on the amount of filament current required by the particular exposure.

In order to complete the filament current control loop, the 20 kHz signal is run through the primary of Current Sample Transformer T2. The Current Sample Transformer's turn ratio is configured such that 1 amp flowing through its primary will result in 1 volt at its secondary. The output of Current Sample Transformer T2 is fed to the input of RMS-to-DC Converter U4. The output from RMS-to-DC Converter U4 is a dc signal that is proportional to the RMS current flowing through the primary of the filament transformer (in the High-voltage Tank). The RMS-to-DC Converter's output is buffered and amplified by Amplifier/Buffer U5A before being sent to the KVP & Filament Control circuit.

U5B is configured as a full-wave rectifier whose output is filtered by R19, R32 and C14. The resulting voltage is input to U1 as a filament current limit signal. R25 can be adjusted to limit the maximum filament current.

The large or small filament is selected by the FIL SIZE signal from the KVP & Filament Control circuit. A high level FIL SIZE signal applied to the Filament Select circuit turns on transistor Q5, which energizes relay K1. When K1 is energized, the small filament is selected. A low level FIL SIZE signal will keep K1 turned off and the large filament will be selected.

KVP & FILAMENT CONTROL CIRCUIT

The KVP & Filament Control circuit controls the high voltage and tube current supplied to the x-ray tube. The x-ray tube current is a function of its filament current. The filament current is controlled by a feedback loop consisting of the KVP & Filament Control circuit and the Filament Control Regulator circuit. The KVP & Filament Control Circuit operates as follows:

The output of the kVp divider within the High Voltage (H.V.) Transformer is input to Anode Amplifiers U1A, U1B and Cathode Amplifiers U2A, U2B as the ANODE FDBK and CATHODE FDBK signals, respectively. The outputs of the Anode and

Cathode Amplifiers are compared with the KV PROGRAM (from voltage at Comparators U1C, U2C) and are also sent to the Logic Circuit via Parallel to Serial A/D U13. Comparator U1C's output varies the output frequency of Pulse-Width Modulator U3, depending on the desired kVp voltage. The output of Pulse-Width Modulator U3 is sent to the anode IGBT Driver Board (part of Power Module Assembly). This board drives the IGBT's, which in turn drive the H.V. Transformer, thus producing the high voltage for the x-ray tube. The cathode Amplifiers (U2A, U2B), Comparators (U1C U2C) and Pulse-Width Modulator U4 work in a similar manner. In lower-power systems, Pulse-Width Modulator U4 is not used, and the outputs of Amplifiers U1B and U2B are summed together to control U4.

Comparators (U6A, U6B), Amplifiers (U1D, U2D) and Comparator U6C monitor the high voltage to check for an over-voltage condition. A watchdog timer (Retriggerable One-Shot U7A) must be triggered every 50 msec. by the TRIGGER input from the Logic Circuit (via Address Decoder U15) in order for an x-ray to occur. If this pulse stream were missing, it would signal a failure condition thus terminating the x-ray and the ERROR signal is output through D-Flip-Flop U12A and Logic Inverter U21A to the Logic Circuit. The 7 TRIGGER signal from the Logic Circuit (generated at the beginning of exposure cycle) is applied to 7-Second One-Shot U7B, which produces a seven-second positive-going pulse. If the exposure is not terminated within seven seconds, D-Flip-Flop U12A and Logic Inverter U21A generate the ERROR signal.

Amplifiers (U10A, U10B), Amplifiers (U10C, U10D) and Driver Q3 monitor the x-ray tube current via an mA sense resistor in the High Voltage Tank and compare this value to the mA Program and Filament Program values (received from the Logic Circuit via Serial to Parallel D/A U16. The FIL CURRENT output from this circuit is a voltage that is sent to the Filament Control Regulator Circuit to vary the filament voltage based on the selected x-ray tube current.

Address Decoder U15, Parallel to Serial A/D U13, and Serial to Parallel D/A U16 enable communication between the Logic Circuit and the KVP & Filament Control Circuit. Parallel to Serial A/D U13 converts analog signals from the KVP & Filament Control Circuit to digital signals for input to the Logic Circuit. Serial to Parallel D/A U16 converts digital signals from the Logic Circuit to analog signals for use by the KVP & Filament Control Circuit.

LINE MONITOR CIRCUIT (NON-SE SINGLE-PHASE AND THREE-PHASE SYSTEMS)

The Line Monitor Circuit consists of three circuits: an input line monitor circuit, a circuit that bleeds off the high voltage from the IGBT capacitor banks and an auto-shutoff circuit that turns off the generator after 1 hour of inactivity. The auto-shutoff circuit also allows the microprocessor to turn off the generator in the event a fault occurs in the system. The operation of the Line Monitor Circuit is as follows:

Input Line Monitor Circuit

The Input Line Monitor Circuit monitors the incoming line voltage to ensure it is at the correct voltage level required for taking an exposure. This circuit is configurable for either single-phase systems (anode capacitor bank only) or

two identical voltage-monitoring circuits (anode and cathode capacitor banks) for three-phase systems.

On three-phase systems, each circuit produces a VSENSE voltage that is proportional to the voltage of the anode or cathode capacitor bank. (The ratio of the voltage across either capacitor bank to the voltage at the output of the line monitor circuit is 100:1). The VSENSE (ANODE) and VSENSE (CATHODE) voltages are sent to the Logic Circuit to determine if the line voltage is within acceptable limits for proper system operation. On single-phase systems, there is one capacitor bank each for the anode and cathode. In this case, the capacitor bank is connected to the anode circuit only (JP1-2 is connected to JP1-3) on the Line Monitor circuit board. The result will be that the microprocessor will read the same capacitor bank voltage at VSENSE (ANODE) and VSENSE (CATHODE).

Capacitor Discharge Circuit

The Capacitor Discharge Circuit connects bleeder resistors across the storage capacitor banks to discharge the capacitors when power is shut off. When the generator on/off switch is turned off, the normally closed contacts of relays K1 and K2 close and each relay connects two 1.2K, 50-watt resistors in series across each capacitor bank, discharging the capacitors to a safe voltage below 24 VDC within two minutes. When the generator on/off switch is turned on, the relay contacts open, disconnecting the resistors from the capacitor banks. A 0.1 uF capacitor in series with a 220 ohm resistor is connected across the normally closed contacts of each relay to prevent arcing whenever the relay contacts open.

In addition to the above, the Line Monitor circuit controls the turn-on in-rush current of the system by shunting the 2 ohm resistors in series with the input transformers of the system only after the +24V LVPS is energized. This permits the transformers to slowly change before the contactor is energized, preventing arcing of the contactor's contacts and over-current conditions on turn-on.

Auto-Shutoff Circuit

The Auto-Shutoff Circuit turns off the system after one hour of non-usage via a command from the Logic Circuit. The Operator Control Panel Circuit contains a microprocessor that monitors the Operator Control Panel (OCP) for any key activation. If no key is pressed on the OCP for a user-selectable period (30-180 mins.), the microprocessor generated AUTO SHUTOFF signal energizes Auto-Shutoff Relay K4. This opens a ground, deactivating System On/Off Relay K4, which turns off the generator via Contactor K1. In order to turn on the generator, the system ON/OFF switch on the OCP has to be set to the OFF position. This turns off Auto-Shutoff Relay K4. When the system ON/OFF switch (on the OCP) is set back to the ON position, a ground signal is sent via Auto-Shutoff Relay K4 to System On/Off Relay K4, thus turning on the generator.

Three-Phase Line Monitor Circuit

When the Line Monitor circuit is configured for three-phase operation, a circuit is present on the Line Monitor circuit board that monitors all three phases of incoming power to detect any phase(s) missing. If one or more phases are missing, Phase A, Phase B or Phase C Optocoupler U4, U5 or U6 turns off immediately for the time period when the phase is not present. As soon as one of the optocouplers turns off, a signal is sent to the Logic Circuit to indicate a fault condition, and prevents an exposure from being taken and stops any exposure in progress. When the three phases are again present, the Logic Circuit resets turns on Reset Transistor Q1, which returns the MISSING PHASE output to an inactive level.

LINE MONITOR CIRCUIT (STORED ENERGY SYSTEMS)

The Line Monitor Circuit consists of four distinct circuits:

- The Battery Monitor Circuit
- The Storage Capacitor Discharge Circuit
- The Generator Auto Shutoff Circuit
- The Battery Charger Circuit

Their operation is as follows:

Battery Monitor Circuit

The Battery Monitor Circuit is composed of four independent voltage monitor circuits that track the two positive (+) and two negative (-) battery arrays, one each of which comprise the independent Anode Tray #1 (lower), and the Cathode Tray #2 (upper) DC Battery Power Supplies.

The sum of each (+) and (-) pair produces a Voltage Sense (VSENSE) signal proportional to the total output voltage present on each tray. The divider ratio is 100:1. The V_SENSE ANODE (TP9) and V_SENSE CATHODE (TP10) analogs are routed to Logic Board A1, which performs an A/D conversion, and via software, monitors and determines if the battery power supply voltages are within acceptable limits for proper system operation.

Additionally, a hardware Over-voltage Fault Detector protects the batteries by forcing a charger shutdown if triggered.

Storage Capacitor Discharge Circuit

The Storage Capacitor Discharge Circuit exists to bleed-off the High Voltage DC Charge on the Anode and Cathode Storage Capacitor Banks once the generator is turned off.

Upon turn-off, the generator's internally switched +24VDC Low Volts Power Supply collapses, allowing the normally closed contacts of Relays K7 and K8 to insert two 1.2 Kohm, 50-watt external bleeder resistors R1A and R1B in parallel with the Anode and Cathode Storage Capacitor Banks. These resistors discharge the capacitors to below 24 VDC within two minutes. When the

generator is turned ON, the relays are again energized, disconnecting the bleeder resistors.

Generator Auto-Shutoff Circuit

The Operator Control Panel's (OCP) microprocessor, located on the OCP Control Board, monitors the OCP keypad for button activity. If no button is depressed on the OCP for a user-defined period, ranging between 30 and 180 minutes, the microprocessor energizes the Auto-shutoff relay K6. This opens the System-ON signal ground path (normally low-true), deactivating relay K5 and turning OFF the generator.

To restore the generator to the ON state, the system's ON/Standby switch on the OCP must first be set to the Standby (⏻) position to release relay K6.

The Auto-shutoff circuit also provides the microprocessor the ability to turn OFF the generator should a critical fault develop in the system.

Battery Charger Circuit

Warning! Be aware high voltage DC is constantly present within the battery arrays and on the Line Monitor/Source Charger Board A8, even when the AC line input power is disconnected.

The Battery Charger consists of two similar power supplies, one positive (+) and one negative (-), both of which are necessary to charge a single battery tray.

220VAC is fed from two independent secondary windings of the AC Mains Power Transformer (T1) to two full-wave bridge rectifiers. The unfiltered +/-283VDC outputs are fed to twin Triacs controlled by Pulse Width Modulated (PWM) switching circuits that simultaneously and continuously direct charging current to the weakest of the two trays (when two are present). Together, these two power supplies provide the needed charging current to each half of both battery arrays.

This arrangement permits the creation of dual, center-grounded, 410VDC Anode and Cathode Stored Energy Power Supplies using just two 205VDC regulated battery chargers. Each charger keeps its half of each battery tray at precisely 205VDC by varying the duty-cycle of its Triac switch from 0% to 100%.

If the Battery Monitor circuit senses an over-voltage condition, it will turn off relays K1 and K3, disconnecting the Triacs from the output of the bridge rectifiers. The charging current will remain interrupted until the over-voltage condition is corrected. An Over-voltage Fault signal is also sent to Logic Board A1, which will return a separate shutdown command to the PWMs for redundant safety.

POWER SUPPLY CIRCUIT

The power supply circuit (see Power Supply Board A6 (AY40-005T) Schematic Diagram in Chapter 6, DIAGRAMS) consists of four power supplies that provide the power needed to the control circuits. Two power supplies (+15VDC and +48VDC) are switching power supplies. The other two power supplies (+24VDC and -15VDC) are linear.

+48 VDC Power Supply

The +48 VDC and +15 VDC power supplies work with the same boost concept design, but some of the components are different between the power supplies.

The +48 VDC Power Supply consists of Bridge Rectifier DB1 that produces a 43 VDC (approximately) output (TP2), which is filtered by capacitor C2. The 43 VDC is chopped by transistor Q1 with inductor L1 in series. When Q1 turns off, the inductor and the DC voltage across C2 supplies voltage to the output. The output is the sum of both voltages. Therefore, the output voltage will never be lower than +43 VDC (neglecting the voltages across components). The time that transistor Q1 is on depends on the input DC voltage and the output load. Pulse-Width Modulator (PWM) U1 samples the output voltage, and it controls Q1 on time to maintain constant output voltage. The output voltage is adjusted to +48 VDC (TP3) with R17 in case there is a problem supplying the filament current as a result of long length high-voltage (H.V.) cables. The +48 VDC output can be adjusted to supply adequate filament current. The maximum adjusted voltage should not exceed +52 VDC.

+15 VDC Power Supply

The +15 VDC power supply works using the same boost concept design as the +48 VDC power supply. The +15 VDC Power Supply bridge rectifier DB4 produces a DC voltage output, which is filtered by capacitor C18. The DC voltage should be approximately +13 VDC (TP10). The DC voltage is chopped by transistor Q2 with inductor L2 in series. When the transistor turns off, the inductor and the DC voltage across C18 supplies voltage to the output. The time that transistor Q1 is on depends on the input DC voltage and the output load. PWM U2 samples the output voltage, and it controls Q2 on time to maintain constant output voltage. The output of the +15 VDC supply has a resettable fuse (F2). When the load exceeds the limit of the fuse, the output shuts off until the overload is removed.

+24 VDC Power Supply

The +24 VDC power supply uses a linear adjustable regulator that produces regulated 24VDC (at TP8). The input DC voltage (approximately 35V) to the regulator comes from bridge rectifier DB4 and filter capacitor C15.

The power supply that produces the -15VDC uses a linear fix output regulator that produces the regulated -15VDC (TP8). The input negative DC voltage (TP7 approximately -21V) to the regulator comes from the bridge rectifier DB2 and filter capacitor C13.

ROTOR BOARD CIRCUIT (NON-HIGH SPEED STARTER SYSTEMS)

The Rotor Circuit (see Rotor Circuit Block Diagram in Chapter 6, DIAGRAMS) supplies the power needed for the tube rotor running at 50/60 Hz. The 50/60 Hz running frequency depends on the input AC line. The power consumption varies depending on the tube. Different tubes need different phase shift capacitor (C1) as recommended by the tube manufacturer. Changing the tube to a different type may require changing the phase shift capacitor connected to J5 (check manufacturer's tube data sheet).

The boost and the run voltages are constant; boost is 220VAC and run is 60VAC.

The operation of the rotor starts during PREP. The ROTOR ON signal comes from the Logic Circuit at J3-1, which is input to Control Circuits. This RELAY ON signal from the Control Circuits turns on relay K2 generating the COM output, which connects the common to the rotor (TP1). The BOOST ON signal (TP6) starts the Boost state by generating the Q1 DRIVE signal to Q1 through the Control Circuits. When the boost period is finished, the BOOST ON signal turns off and the RUN ON signal turns on (J3-3). By turning on the RUN ON signal (TP7) and turning BOOST ON off, Q1 turns off and Q2 turns On. The RUN ON signal will remain on throughout the PREP and Expose states. In case the tube's thermal switch is activated (indicated by active TEMP. FAULT signal), Relay K2 will open removing power to the rotor, and the Control Circuit will turn off either Q1 or Q2. A "Rotor Thermal Error" will be displayed on the OCP.

The Main (TP2) and Phase (TP4) currents are sampled by the Control Circuits to determine whether the rotor is rotating (when rotating, the ROTOR ROTATING signal at J3-4 is active). If the ROTOR ROTATING signal is inactive, an error will be displayed on the OCP. Power needed for operation of the Control Circuits and Relay K2 is supplied through connector J4.

ROTOR BOARD CIRCUIT (QUANTUM INTERNAL HIGH SPEED STARTER SYSTEMS)

The following applies only to systems equipped with a Quantum-manufactured High Speed Starter (Q-HSS). The Q-HSS functions to drive the rotating anode of many types of 3" or 4" x-ray tubes. The tube anode rotates at either of two distinct speeds/frequencies; low speed operation (60 Hz) or high speed operation (180 Hz).

All necessary settings for the high speed starter are configurable by accessing the generator's Service Configuration screen (refer to Chapter 3, CALIBRATION).

The Q-HSS consists of two circuit board assemblies: HSS Control Board A20A1 (AY40-035S) and HSS Drive Board A20A2 (AY40-036S).

All required settings needed for high speed starter timing and control are known to Logic Board A1, The BOOST RUN/ BRAKE voltages are set based on tube model.

Refer to Chapter 2, ASSEMBLY & INSTALLATION for HSS Driver Board AY40-036S transformer input wire connections to terminal block TB1 plug and for wiring configuration of rotor phase capacitor.

HSS Control Board A20A1 (AY40-035S)

The HSS Control Board A20A1 receives operating handshake commands (such as SYSTEM ON/OFF) from the generator Logic Board A1 (AY40-004S) through connector J2. The signals coming and going to the Logic board via J2 are optically isolated. The handshake signals control the high speed starter's Rotor On, Boost, Run and Brake sequence. The Boost and brake time settings are based of the tube model selected for the generator.

CAUTION! It is important that the proper tube is selected otherwise damage may be caused to the tube rotor due to incorrect Boost and/or Brake timing.

Oscillator A20A1U11 generates a 36 kHz square wave output, which is then divided by counters to create 180 Hz (High Speed) and 60 Hz (Low Speed) reference frequencies required to synchronize all control events.

The 60 Hz and 180 Hz drive outputs each consisting of two, 180° out-of-phase signals, DRIVE 1 and DRIVE 2 (available for monitoring at A20A2TP5, A20A2TP6). These outputs are buffered and then sent as drive signals to IGBTs on HSS Drive Board A20A2. Under the control of the generator Logic Board A1 and HSS Control Board A20A1, relays on the HSS Drive Board output a sequence of AC voltages (High/Low Speed Boost and Run) to the x-ray tube based on the tube type configured in the generator. Redundant hardware protection is provided to limit maximum Boost and Run times.

For High Speed (180 Hz) operation, following the end of the Run phase, a Brake phase is initiated. During this phase, one output phase is On while the other is Off. The DC braking voltage is generated through rectification of the Run AC voltage. The duration of the Brake phase is dependent on the tube type selected.

The high speed starter voltage and current on HSS Drive Board A20A2 are monitored continually by circuits on HSS Control Board A20A1. If an over-voltage or over-current condition occurs, the HSS Control Board terminates operation of the high speed starter. Test point A20A1TP10 provides the indication of over-voltage or over-current (i.e., TTL-low signal indicates FAULT condition).

The HSS Control Board A20A1 also monitors whether or not the tube is rotating (ROTATING signal at A20A1TP19), and whether it is rotating at High Speed 180 Hz or Low Speed 60 Hz (HIGH/LOW SPEED signal at A20A1TP8). If the ROTATING signal at A20A1TP19 is not logic low during operation of the high speed rotor, a "Not Rotating" error appears on the Operator Control Panel display.

The available test points on HSS Control Board A20A1 are:

- TP1: GND
- TP2: +15V

- TP3: -15V
- TP4: +5V
- TP5: Drive one side of the bridge (TTL)
- TP6: Drive second side of the bridge.
- TP7: Boost On (High TTL)
- TP8: High/Low Speed
- TP9: Rotor Run
- TP10: Over Voltage or Over Current (TTL Low = Fault)
- TP15: 36 kHz Clock
- TP17: +5V Reference
- TP19: Rotating Signal (Low = Tube Rotor rotating)

HSS Drive Board A20A2 (AY40-036S)

The main function of the HSS Drive Board A20A2 is to deliver AC drive voltages to the rotor at 60 Hz and 180 Hz frequencies using a bridge driver circuit. To protect the bridge driver circuit, the HSS Drive Board contains fault detection and overload protection circuits.

The DC voltage for the bridge is provided by Bridge Rectifier A20A2BD30. A set of relays located on HSS Control Board A20A1 control the AC voltage supply to Bridge Rectifier A20A2BD30 based on the operational state of the high speed starter (i.e., High/Low Speed Boost, Run, or Brake). Capacitors A20A2C4, -C5, -C8, and -C9 filter the rectified DC voltage.

The drive for the bridge driver is input from HSS Control Board connector J1 into HSS Drive Board A20A2 connector J3. The drive is monitored on test points A20A2TP5 and A20A2TP1.

Relay A20A2K1 sets the value of the rotor phase capacitors in accordance with the speed at which the high speed starter is operating. The values phase capacitors will be set based on the tube type.

A triple-output floating power supply provides power to the HSS Drive Board IGBT drivers. The switching power supply pulse-width modulated (PWM) output provides a pulse that is a function of the voltage. The output of the PWM can be monitored at test point is A20A2TP12. The feedback test point is A20A2TP13. The voltage at this point is 18 VDC.

For protection against overload of the bridge circuit output, current sensors monitor output current (available at test points A20A2TP2 and A20A2TP6). If current exceeds maximum threshold level, the high speed starter shuts down the rotor and an Over Current/Voltage signal is output to HSS Control Board A20A1. Similarly, the Main to Common voltage is monitored at test point A20A2TP14 (sample of the output voltage). If the voltage exceeds a preset voltage threshold, the high speed starter shuts down the rotor and an Over

Current/Voltage signal is output to HSS Control Board A20A1. In response to the Over Voltage/Current signal, the HSS Control Board A20A1 monitors the signal and sends a Fault signal to the generator Logic Board A1, and a "Rotor Current" error appears on the Operator Control Panel display.

The x-ray Tube Temperature input signal is applied through terminal block A20A2TB4. The Tube Temperature input is protected with Fuse A20A2F5. If the voltage on A20A2TB4-1 is above one volt, a Temp error signal is generated. The TEMP signal is output through connector A20A2J2 to HSS Control Board A20A1, which then activates a temperature signal to generator Logic Board A1. In response, a "Rotor Temp" error is indicated on the Operator Control Panel display.

The following are the ratings of the various fuses located on HSS Drive Board A20A2:

- F1, F3: AC Input voltage - 15A/500VAC
- F4: Rotor output drive - 15A/500VAC
- F5: Temperature sense input - 0.1A/250V

AEC BOARD CIRCUIT

The automatic exposure control (AEC) option is available in either of two types: Standard or Universal. The standard type provides for connection of up to two ion chambers, one for a wall mounted image receptor and one for a table mounted receptor. Both ion chambers must be of the same type, i.e., either "slope" or "level". The universal type provides for connection of up to four separate ion chambers, each one can be either type (slope or level). The following paragraphs describe general circuit functions of each AEC type.

Standard Type AEC

The standard type AEC Board A11 (AY40-031S) controls the exposure time to maintain uniform optical density (O.D.) with respect to various kV and mA settings. Using AEC, the operator sets the desired kV and mA; the exposure time is determined by the AEC circuit. AEC calibration is required in order establish a desired or optimal optical density (refer to Chapter 3, AEC Calibration).

The AEC Board is designed for use with ion chambers having the following characteristics:

- Positive slope
- Ion chamber selection signal: active low
- Ion chamber on signal: active low

The AEC Board can control two separate ion chambers; each of the ion chamber connectors is a D-type connector (A11J2 = Wall 1 and A11J5 = Table). The ion chamber is selected from the operator control console via the TABLE and WALL receptor keys. These selections are input to control logic contained on Logic Board A1 AY40-006S, which controls the selection of the ion

chamber and the detectors within the selected ion chamber. The AEC board receives the voltage input from selected ion chamber, and processes the signal. The processed signal is compared continuously with a set reference voltage produced by KVP Board A2 AY40-003S. The reference voltage is a function of kVp and the film/screen combination type. When the processed signal is equal to the reference voltage, the exposure is terminated.

The AEC Board A11 AY40-031S "fine" gain adjustment potentiometers are as follows:

- A11R22 Table gain adjustment
- A11R23 Wall 1 gain adjustment
- A11R24 Wall 2 gain adjustment (currently not used)

The above potentiometers provide fine gain adjustments for each of the ion chamber detectors, coarse gain adjustment is performed by adjusting the MASTER GAIN potentiometer located on the ion chamber. A11R12 provides AEC dV/dT adjustment as described in the AEC calibration instructions in Chapter 3. The following major test points and a brief description are:

- TP1- Wall 1 input from ion chamber
- TP2- Wall 2 input from ion chamber
- TP5- +15V supply to ion camber
- TP6- -15V supply to ion camber
- TP7- Table input from ion chamber
- TP9- Inverted polarity slope of selected ion chamber signal
- TP12- AEC output to KVP board

Universal Type AEC

The "universal" AEC Board A11 (AY40-027S) has the capability to work with two ion chambers (four in the future), and provides necessary interface to connect to the Siemens tomography system (or any other tomography system having similar hand-shake protocol as Siemens). The universal AEC Board is capable of working with ion cambers that have different type of outputs (Slop / Level), polarity (Positive / Negative), or logic levels. (active low, active high.) The ion chamber configuration/ setting can be set through setup menus in the calibration setup mode. The settings options to ion chamber type that can be programmed are:

- Ion chamber cell selection
- Type of the ion chamber output slope/level
- Polarity of the AEC output signal
- The level of ion detectors selection signal (active low/active high). The ion chamber ON (Reset) is always active low.

The board is divided into three major functions described in the following paragraphs:

- +300 VDC power supply
- AEC Control Circuit
- Tomography Interface Circuit

+300 VDC Power Supply

The universal board has an adjustable +300 VDC power supply for ion chambers that require +300 VDC for the detector operation (e.g., Siemens ion chamber). The power supply is a DC-to-DC converter that converts +50 VDC (input through A11J1) to +300 VDC. The power supply is regulated with closed-loop circuitry. A11R10 adjusts the power supply output on connector A11TB1. The power supply has a thermal fuse (A11F1) and current limit protection against short circuits (A11U1).

AEC Control Circuitry

The AEC control circuitry can accept one out of two ion chamber inputs (either wall or table) based on selection from the OCP. (In the future, four inputs will be available.) The ion chambers input connectors are 9-pin D-type connectors, configured as follows:

- A11J10 - Table ion chamber, selected from the OCP as TABLE receptor.
- A11J8 - Wall #1 ion chamber, selected from the OCP as WALL receptor.
- A11J12 - Currently not available for use.
- A11J13 - Currently not available for use.

Different types of ion chamber can be connected to each input. Each ion chamber is configured independently using the Ion Chamber Configuration menu to set the characteristics of the ion chamber. These settings enable the AEC Control circuitry on the Universal Board to generate the appropriate signal. The information is sent via serial communication from the OCP Control Board to the Logic board, then to the Universal AEC Board. The selected ion chamber outputs a signal that is processed by the AEC Control circuit and is sent to the KVP Control Board. The KVP Control Board compares the processed signal with a reference voltage. When the processed signal is equal to the reference voltage, the exposure is terminated.

The AEC Control circuitry requires adjustment using potentiometers. The potentiometers are adjusted during AEC calibration based on the ion chamber type and film/screen combination. The circuits are divided into two sections: one for a level type ion chamber, and one for a slope type ion chamber.

The adjustment potentiometers functionality:

Table 4-1. Universal AEC Board Ion Chamber Adjustments

Table Ion Chamber Type	
Slope	**Level**
dV/dt adjustment: A11R87 - Adjust once for either the table or wall ion chamber (both must be "slope" type ion chambers)	Ion chamber output balance: A11R61 - Field 1 (Center), A11R63 - Field 2 (Left)*, A11R66 - Field 3 (Right)*
	dv/dt adjustment: A11R82 - Adjust once for either table or wall ion chamber (both must be "level" type ion chambers)
	Fine gain adjustment: A11R77 - table ion chamber gain adjustment
	All other potentiometers are for future use.
Wall Ion Chamber Type	
Slope	**Level**
dV/dt adjustment: A11R87 - Adjust once for either the table or wall ion chamber (both must be "slope" type ion chambers)	Ion chamber output balance: A11R61 - Field 1 (Center), A11R63 - Field 2 (Left)*, A11R66 - Field 3 (Right)*
	dv/dt adjustment: A11R82 - Adjust once for either table or wall ion chamber (both must be "level" type ion chambers)
	Fine gain adjustment: A11R79 - wall ion chamber gain adjustment
	All other potentiometers are for future use.
*Note: Settings indicated are for right hand load side; for left hand load, use A11R63 to adjust right field and A11R66 for left field.	

Tomography Circuitry

The universal AEC Board provides interfacing circuitry to the Siemens tomography system (and to other tomography systems that have similar hand-shake interface). The Tomography circuitry contains the signal sequence needed to take an exposure using a Siemens table (including a Tomo table) or a Siemens wall stand. In addition, it includes the sweep time detection circuitry that detects tomography mode of operation.

When Tomo Mode is detected, the operator control panel automatically displays Tomo Mode screen. The Tomo Mode screen displays an icon indicating Tomo Mode, and the exposure "time" is changed to "sweep time". The exposure hand-shake control signals are received from the Logic Board and Interface Board. These signals are activated during PREP and EXPOSE states, and are sent and received from either the tomo table or wall stand. The Tomo Mode detection circuitry receives the tomo sweep time from the tomo table. The Universal AEC Board detects the selected tomo sweep time, and sends it to the Logic Board. The Logic Board sends the data to the OCP via serial communication protocol.

Chapter 5

SERVICE INSTRUCTIONS

OVERVIEW

The HF Series X-ray Generator will function reliably when maintained according to the instructions provided in this chapter. Only properly trained service personnel should service or maintain this equipment. Safe equipment performance requires the attention of service/support personnel who are specifically trained and experienced with medical x-ray apparatus. Applicable preventive maintenance or any repair service should be performed by these skilled individuals. Failure to follow manufacturer's or service personnel's recommendations may result in serious injury. This chapter also includes a detailed component listing of the generator's replaceable parts.

WARNING! Before removing or opening any electrical power panels or covers, verify that the incoming power supply is turned OFF. In the event maintenance procedures require power to be supplied to the unit, extreme care MUST be exercised to insure the safety of service or other personnel in the area. Verify that the equipment is properly grounded before attempting any electrical operation.

WARNING! Service/Support personnel must be qualified, having been trained in understanding and avoiding the electrical hazards of working on or near exposed energized parts.

CAUTION! This equipment contains electrostatic sensitive devices. Observe proper grounding precautions before handling components or printed circuit boards.

DISPOSAL OF BATTERIES AND ACCUMULATORS (DIRECTIVE 2006/66/EC)

In accordance with the European Directive 2006/66/EC, batteries and accumulators are labeled to indicate that they are to be collected separately and recycled at end of life. The label on the battery may also include a chemical symbol for the metal concerned in the battery (Pb for lead, Hg for mercury and Cd for cadmium). Users of batteries and accumulators must not dispose of batteries and accumulators as unsorted municipal waste, but use the collection framework available to customers for the return, recycling, and treatment of batteries and accumulators. Participation is important to minimize any potential effects of batteries and accumulators on the environment and human health due to the potential presence of hazardous substances.

Chapter 5 Service Instructions

SERVICE MAINTENANCE

WARNING! Always disconnect the equipment from the main power supply prior to any cleaning.

WARNING! STORED ENERGY (SE) systems have live high voltage present even with system powered off. Areas where high voltage is present includes the battery tray fuse holders, contactor K1, rectifier DB1, and Line Monitor/Battery Charger Board A8.

To keep the HF Series X-ray Generator operating properly, it must be inspected and calibrated at regular intervals, depending on the age and use of the equipment. When there is a problem, call a Quantum Medical Imaging-recognized service technician. Do not operate equipment until all repairs are complete.

Periodic planned maintenance is required to maintain the system in good working order and to insure operational reliability. It is recommended that the Service/ Support Technician be prepared with the standard tools and equipment required for the service call.

Visual Inspection

A complete series of inspections and functional checks was conducted at installation to insure proper operation of the system. The following inspection and adjustment procedures are recommended to maintain the system in its original operating condition.

Perform Every Six Months:

- Check for evidence of loose hardware or loose wires
- Conduct a general inspection for worn or damaged parts
- Verify that all ground conductors are properly and securely installed and free of corrosion or damage
- Check all electrical cabling and wiring for wear and fraying
- Check for any indications of oil leaking from the H.V. Tank

Perform Every Twelve Months:

- Verify accuracy of kVp, mA, and filament calibrations and, if equipped, check AEC calibration (refer to Chapter 3, CALIBRATION)

Use the Reproducibility, Linearity, and Maximum Deviation data test procedures and Calibration Data Sheets provided at the end of Chapter 3, and verify that all calibrations are within specified tolerances as stated in Chapter 2, SPECIFICATIONS; this is required to demonstrate compliance. If the generator is interfaced to an external imaging system that is used as the generator's operator control panel, (e.g., an Agfa NX Workstation

integration or Canon DR Integration System), refer to accompanying service documentation provided with integration system for operator control panel FDA certification instructions.

TROUBLESHOOTING

This section is provided for technicians to assist in locating and correcting minor system faults, should they occur. When the unit will not expose, an audible alert will sound and one or more “warning" or “error code” message(s) will appear on the Operator Control Panel display. In the event the READY indicator on the operator control panel is not lit following an audible alert, pressing the PREP key will display an error message indicating the reason the system is not responding.

Warning Messages

Refer to the Operator’s manual for a list of system warning messages that do not require the attention of a service representative. These messages can be cleared by correcting the indicated problem (e.g., x-ray room door open) and then pressing any key on the operator control panel.

Error Codes

IMPORTANT NOTE: If the generator is interfaced to an external imaging system that is used as the generator’s operator control panel, (e.g., an Agfa NX Workstation integration or Canon DR Integration System), refer to accompanying service documentation provided with the integration system for a list of applicable error codes and remedial actions relevant to integration issues.

Refer to the following descriptions for assistance in interpreting the error

code displayed on the Operator Control Panel:

Table 5-1. Error Messages and Possible Cause(s)

Error Message	Possible Cause(s)	Remedial Action
READY LED blinking	Note: A brief period of blinking is normal when the unit is first turned on or following an exposure. 1. 400 V Not ready for exposure. 2. On stored energy (SE) units, batteries not ready for exposure (i.e., in charging mode). 3. Heat units are exceeded.	1. If blinking is continuous, verify the line voltage is high enough. (Check voltage across capacitor bank (C9-C12 and C13-C16 on single-phase units, C1-C4 on SE units, or C9-C12 and C13-C16 on three-phase units) to see if it is out of range (i.e., 380-420 VDC).) 2. Check AC input transformer tap adjustment for correct line voltage tapping. 3. Check for 24 VDC at Power Supply Board A6 (AY40-005T) +24 VDC test point. If +24 VDC not present, turn off generator and remove plug from Power Supply Board A6 (AY40-005T) connector J2 and re-check +24 VDC test point. If +24 VDC is present, something is loading down voltage.

Table 5-1. Error Messages and Possible Cause(s)

Error Message	Possible Cause(s)	Remedial Action
READY LED not illuminated	1. Generator Cabinet ON/OFF Circuit Breakre is OFF. 2. ON/STDBY Rocker Switch on OCP (non-Q-Connect Systems) or Power/Expose Control Box (Q-Connect Systems) is set to STDBY. 3. Facility electrical has been interrupted. 4. Filament automatically shuts off after 60 minutes of inactivity. 4. The exposure setting(s) exceed the tube or model limits. 5. Faulty communications between generator and OCP. 6. Incorrect generator program or generator is not working. 7. Lost communication between OCP and generator cabinet.	1.Verify that the ON/OFF Circuit Breaker on Generator is ON. 2. Set ON/STDBY Rocker Switch on OCP (non-Q-Connect Systems) or Power/Expose Control Box (Q-Connect Systems) to ON. 3. Check, and if possible, reset Facility electrical service. 4. Press PREP key. An error message displays on the operator control panel. Refer to appropriate error message listed in this table for error details. Press any key to clear error. System should now be ready for exposure. 5. Non-Q-Connect Systems only: Check serial cable connection between OCP and generator cabinet and jumper settings on OCP Control Board (AY40-004S1).
400 Volt Anode	See "Line/400V Anode" message	See "Line/400V Anode" message
400 Volt Cathode	See "Line/400V Cathode" message	See "Line/400V Cathode" message
AC Volt Diff	Output by Logic board, indicating a hardware failure when a significant difference between Anode and Cathode voltage is detected. *Note: This error applicable on Q-Connect Systems only.*	Proceed to "KVP Error" and troubleshoot accordingly.
ADC Negative 15	See "Minus 15V" message	See "Minus 15V" message
ADC Negative Reference	See "Vref-" message	See "Vref-" message

Table 5-1. Error Messages and Possible Cause(s)

Error Message	Possible Cause(s)	Remedial Action
ADC Positive 15	See "Plus 15V" message	See "Plus 15V" message
ADC Positive 5	See "Plus 5V" message	See "Plus 5V" message
ADC Positive Reference	See "Vref+" message	See "Vref+" message
ADC Regulated Positive 24	See "Plus 24V" message	See "Plus 24V" message
ADC Unregulated Positive 24	See "V24 Brake" message	See "V24 Brake" message
AEC Not Installed	No AEC hardware present.	Check AEC cable is connected and/or is not defective. Verify AEC Board is installed.
AEC No Bucky	AEC chamber not selected, or is not functioning properly.	Check operation of selected ion chamber.
Anode Heat or Housing Heat	Indicates that the tube maximum heat load capacity will be exceeded if exposure is taken at current exposure factors.	Reduce technique factor(s) and/or wait until tube cools sufficiently. Retake exposure.
Anode Volt	Indicates that there is a problem with the anode kVp circuit, high voltage transformer, or Power Driver Module. (Note: If the remedial actions given do not correct fault, refer to the "Cathode Volt" error message and perform applicable remedial actions.)	1. Visually inspect the Anode Power Driver Module A18 (on right side) for damage. 2. Check for output drive signal from KVP Control Board A2 as follows: Disconnect plug from A2J7 and A2J8. Connect oscilloscope probe (CHAN 1) to A2TP21 and CHAN 2 probe to A2TP22. Set oscilloscope time base to 5 µsec./div. and the vertical amplitude to 5V/div. Take an exposure. An "Anode Volt" error will display and the following waveform should be obtained:

Table 5-1. Error Messages and Possible Cause(s)

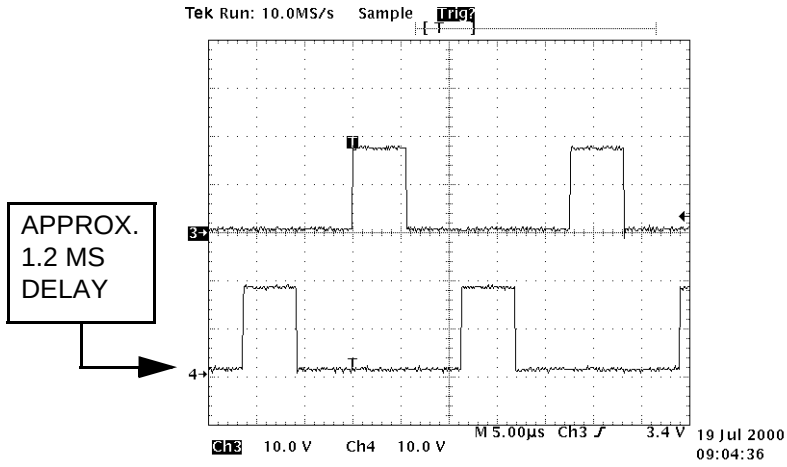
Error Message	Possible Cause(s)	Remedial Action
		
Anode Volt (Cont'd)		3. If waveform is correct, go to step 4. If not, replace KVP Control Board A2 and re-check drive signal as described in the previous step. If problem persists, replace Logic Board A1 (AY40-006S) and re-check. If still not corrected, check wiring.

Table 5-1. Error Messages and Possible Cause(s)

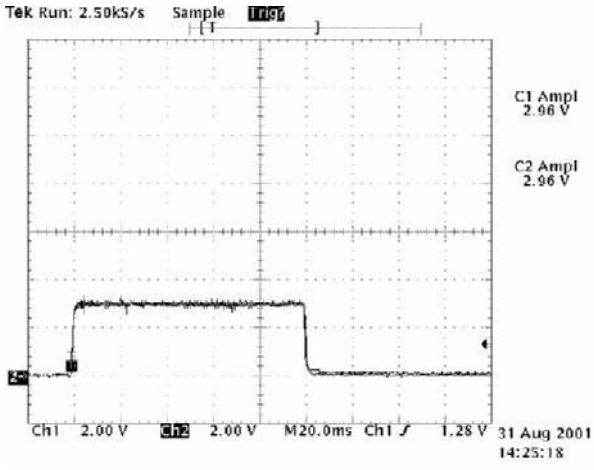
Error Message	Possible Cause(s)	Remedial Action
		4. Re-connect cable plugs to connectors J7 and J8 on KVP Control Board A2. 5. On KVP Control Board A2, connect oscilloscope probe to A2TP1 (Anode Sense) and take an exposure. A short exposure and error message will occur. Waveform should be as shown below: The equivalent kV value should be approximately half the indicated kV value on OCP (e.g., 25 kV for 50 kV setting on OCP). If kV value is acceptable, check H.V. Transformer. If value is not correct, replace KVP Control Board A2 (may be faulty A/D Converter). If problem still exists, replace Logic Board A1 (AY40-006S).
 Sample waveform above is with operator control panel set for 50 kVp, 200L mA, 100 ms. (Each volt measured represents 8.2 kV.) If spikes are present, this indicates arcing in either the x-ray tube or high voltage transformer.		

Table 5-1. Error Messages and Possible Cause(s)

Error Message	Possible Cause(s)	Remedial Action
Anode Volt (Cont'd)		6. Verify AC line voltage meets specification during an exposure: Check capacitor voltage (C9-C12 and C13-C16 on single-phase units, C1-C4 on SE units, or C9-C12 and C13-C16 on three-phase units) is between +350 and +440 VDC. The power must be sufficient to support the exposure (i.e., check for weak AC Line). 7. Verify that all grounds are good (JP2-JP9 installed or shorted on Logic Board A1 (AY40-006S)).
APR Tree Load Error {text string}	An error occurred while loading the APR tree. Note: {text string} will contain additional details.	Call Technical Service/Support.
Backup	Backup time was reached based on current technique factors.	1. Reduce technique factor(s). Retake exposure. 2. Verify ion chamber cable connections are correct and secure. 3. On AEC Control Board A11 (AY40-031S or AY40-027S), check +15 VDC and -15 VDC outputs are not loaded down. If so, remove ion chamber cable connection and recheck voltages. If +15 VDC and /or -15 VDC outputs are now good, ion chamber is at fault. If still loaded down, replace AEC Control Board. 4. Verify the Backup Time/mAs settings in APR view (if caused during APR mode) and/or Backup Time/mAs in Service Settings configuration screen are set correctly (i.e., not too low).

Table 5-1. Error Messages and Possible Cause(s)

Error Message	Possible Cause(s)	Remedial Action
Battery Dis-charged Battery 2 Dis-charged	Faulty stored energy cell in top battery tray (Cathode on two tray systems) or Line Monitor/Charger board not adjusted correctly. Faulty stored energy cell in bottom battery tray (Anode on two tray systems) or Line Monitor/Charger board not adjusted correctly.	1.. Connect a DMM to Line Monitor/ Charger Board A8 AY40-028T test point TP2 and ground. Verify voltage is +204 to +206 VDC. If not, adjust A8R70 to obtain correct voltage. If voltage cannot be adjusted to correct value, replace Line Monitor/Charger Board A8. 2. Connect a DMM between Line Monitor/Charger Board A8 test point TP3 and ground. Verify voltage is -204 to -206 VDC. If not, adjust A8R66 to obtain correct voltage. If voltage cannot be adjusted to correct value, replace Line Monitor/Charger Board A8. 3. Check each stored energy cell in battery tray. Voltage of each cell should be 12.5 VDC minimum. If not, replace cell. 4. Check A8K1 and A8K3 operation as follows: Turn A8R19 and A8R60 fully counterclockwise. Verify voltages between A8TP20 and GND and A8TP21 and GND are less than 1.0 VAC. Turn A8R19 and A8R60 fully clockwise. Verify voltage between A8TP15 and GND and A8TP16 and GND are +283 VDC and -283 VDC, respectively. 5. Connect a DMM between A8TP21 and GND. Adjust A8R19 to measure +2.10 - +2.14 VDC. 6. Connect a DMM between A8TP20 and GND. Adjust A8R60 to measure +2.10 - +2.14 VDC.

Table 5-1. Error Messages and Possible Cause(s)

Error Message	Possible Cause(s)	Remedial Action
Battery Over-Charged Battery 2 Over-Charged	Line Monitor/Charger board not adjusted correctly.	1. Connect a DMM between Line Monitor/Charger Board AY40-028T test point TP2 and ground. Verify voltage is +204 to +206 VDC. If not, adjust A8R70 to obtain correct voltage. If voltage cannot be adjusted to correct value, replace Line Monitor/ Charger Board A8. 2. Connect a DMM between test point TP3 and ground. Verify voltage is -204 to -206 VDC. If not, adjust A8R66 to obtain correct voltage. If voltage cannot be adjusted to correct value, replace Line Monitor/Charger Board A8.
Battery NotRdy	Battery voltage is too low. (This warning message applies only to stored energy generators.)	Wait until READY light on Operator Control Panel is steady before taking exposure.
Calibration	Generator kV, mA, and/or filament calibration settings are outside of acceptable limits for normal system operation.	Access Service Mode and perform kV, mA, and/or filament calibration.

Table 5-1. Error Messages and Possible Cause(s)

Error Message	Possible Cause(s)	Remedial Action
Cathode Volt	The filtered cathode volts are outside of preset limits at any time. (Note: If the remedial actions given do not correct fault, refer to the "Anode Volt" error message and perform applicable remedial actions.)	1. Visually inspect the Cathode Power Driver Module A19 (on left side of cabinet) for damage. 2. Check for output drive signal from KVP Control board A2. Disconnect plug from A2J7 and A2J8. Connect oscilloscope probe (CHAN 1) to A2TP23 and CHAN 2 probe to A2TP24. Set oscilloscope time base to 5 µsec./div. and the vertical amplitude to 5V/div. Take an exposure. An error will occur and the same output drive waveform shown in the "Anode Volt" procedure on previous pages should be obtained. 3. If waveform is correct proceed with step 5. 4. If waveform is not as indicated, replace KVP Control Board A2 and re-check drive signal as described in previous step. If problem persists, replace Logic Board A1 (AY40-006S) and re-check. If still not corrected, check wiring. 5. Re-connect plugs into A2J7 and A2J8. 6. On KVP Control Board A2 (AY40-003S), connect oscilloscope probe to TP2 (Cathode Sense) and take exposure. The same voltage output waveform shown in the "Anode Volt" procedure on previous pages should be obtained. 7. The equivalent kV value should be approximately half the indicated kV value on OCP. If kV value is acceptable, check H.V.Transformer. If kV value is not acceptable, perform steps 8 through 10.

Table 5-1. Error Messages and Possible Cause(s)

Error Message	Possible Cause(s)	Remedial Action
Cathode Volt (Cont'd)		8. AC line voltage is out of specification during an exposure. Check the capacitor (C9-C12 and C13-C16 on single-phase units, C1-C4 on SE units, or C9-C12 and C13-C16 on three-phase units) voltage is within range (i.e., 350 to 440 VDC). 9. Verify that all grounds are good (JP2-JP9 installed or shorted on Logic Board A1 (AY40-006S). 10. Verify that the power is sufficient to support the exposure (i.e., check for weak AC Line).
Collimator	Automatic collimator not responding (only appears on systems using an automatic collimator).	1. Positive beam limitation (PBL) circuit is open; check PBL cable connection between generator and table. 2. Verify jumper JP1 is not installed on Interface Board A9 (AY40-023T).
Configuration Load Error {text string}	An error occurred while loading the configuration. Note: {text string} will contain additional details.	Call Technical Service/Support.
Door	Entrance door to x-ray room is open.	Verify x-ray room door is closed and re-take exposure.
Early Term	Exposure terminated prematurely because EXPOSE key was released before exposure was completed.	Press any key/button on Operator Control Panel to clear warning message. Re-take exposure.
Error - An error occured while loading a view. Please check the APR tree.	When trying to load a view's parameters an error occurred. This is typically because of an invalid APR tree (missing value or out-of-range value).	Load APR editor and fix {0} = Location i.e., generator, collimator, etc. {1} = AnatomicalRegion {2} = ViewName {3} More details about this error.

Table 5-1. Error Messages and Possible Cause(s)

Error Message	Possible Cause(s)	Remedial Action
Error - Could not open file {text string}	There was a problem loading the selected APR tree. Note: {text string} will contain additional details.	1. Wrong file was selected. 2. File is corrupt.
Error - Only one instance of the application can be run at a time.	Opening up of a second instance of the same program was attempted by the user.	Only one instance of the application can be run at a time.
Expose WDT	Exposure sequence disabled due to loss of communication with EXPOSE watchdog timer.	Call Technical Service/Support.
Exposure Lock	The CR/DR system is blocking the exposure for: 1. Trying to expose a body part that has already been exposed. 2. The CR/DR system is not in an acquisition mode.	1. Place the system in valid acquisition mode. 2. In case of Emergency, press URGENT button to override exposure lock.

Table 5-1. Error Messages and Possible Cause(s)

Error Message	Possible Cause(s)	Remedial Action
Filament Curr	Indicates a problem with the filament control regulator circuit voltage.	1. Access Service Configuration menu and verify the correct tube is selected. 2. Check for +48 VDC on Power Supply Board A6 (AY40-005T) TP3. 3. Check that Fuse F1 on Interface Board A9 (AY40-023T) is not open. If so, replace F1. 4. On Filament Control Board A5 (AY40-007T), verify fuse F1 is not open. If so, replace F1. (If fuse blows again after replacement, replace Filament Control Board A5. 5. Connect DMM to TP11 on Filament Control Board A5 and ground. With system on, the meter should measure +24 VDC. Select a small filament mA station and press PREP. The meter should measure 0 VDC. If either of these tests fail, replace Filament Control Board A5. 6. If none of the above steps solve the problem, replace KVP Control Board A2 (AY40-003S). 7. If replacing KVP Control Board does not correct problem, replace Filament Control Board A5 (AY40-007T). 8. If replacing Filament Control Board does not correct problem, replace Logic Board A1 (AY40-006S).
Filament Prog	The filtered Filament Amps are outside of preset limits at any time. Indicates that there is a problem with either: 1. D-A circuit on the KVP Control Board A2. 2. Filament Control Board A5 (AY40-007T) regulator A-D.	1. Verify -15 VDC at TP5 on Power Supply Board A6 (AY40-005T). 2. Replace KVP Control Board A2 (AY40-003S). 3. Check fuse F8 on Interface Board A9 (AY40-023T). 4. Check for loose connector A6P2. 5. Replace Filament Control Board A5 (AY40-007T).

Table 5-1. Error Messages and Possible Cause(s)

Error Message	Possible Cause(s)	Remedial Action
Filament Too Low	The OCP sent a request to the Generator to set a PREP value that is too low.	1. Verify that the tube selected in the Service / Config / Tube is that which is physically installed in system. 2. Make sure that Filament Calibration has been completed correctly. 3. Verify that "Reset Tube" has been selected when exiting the Select Tube screen. 4. Verify that the filament is working. If it is not, go through the troubleshooting steps of "Filament Curr" error.
Flash	Flash memory returned incorrect checksum.	Check A16U2. Call Technical Service/Support.
Flash Not Loaded	1. Flash Memory (U2) on OCP Control Board A16 (AY40-004S1) not loaded with program that corresponds with the version of the Microcontroller program in the OCP. 2. Flash Memory is experiencing a read problem. (The Flash is continuously read during operation and an error displayed if checksums or versions are not correct.)	1. Verify version of the OCP Control Board microcontroller U2 software is correct by looking at the label on U2. A method of checking the installed software versions are accessing service mode menus Service / Reports / Checksums. The "Internal" and "External" versions must be the same and checksums valid or many functions (such as PREP and EXPOSE) are inhibited. 2. A16A1U2 may be damaged - replace OCP Control Board.

Table 5-1. Error Messages and Possible Cause(s)

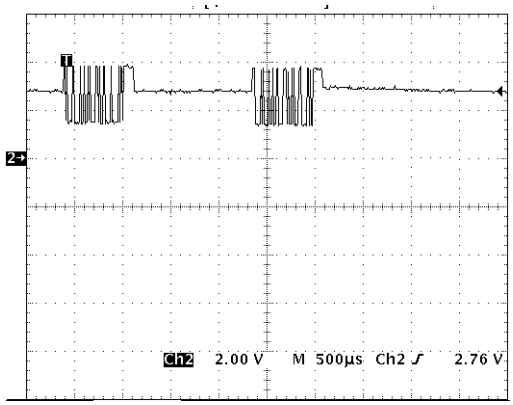
Error Message	Possible Cause(s)	Remedial Action
Generator Comms	Operator Control Console lost communication with generator cabinet. Can be caused by: 1. Faulty or improperly installed OCP Serial Cable 2. Non-Q-Connect Systems only: Improperly configured jumpers on OCP Control Board A16 (AY40-004S1) or Logic Board A1 (AY40-006S) 3. Failed transceivers on A1 and/ or A16 boards. 4. Logic Board A1 microproces-sor A1U9 faulty, not properly seated in socket, or loaded with incorrect program. 5. +5 VDC supply to Logic Board A1 too low.	Non-Q-Connect Systems only: On OCP Control Board A16 (AY40-004S1), connect oscilloscope to test point TP2. With system turned on and idling, verify waveform is as shown below. There should be a set of two pulses approximately every second. The first pulse is sent from the OCP Control Board to the Logic Board. The second pulse is sent by the Logic Board to the OCP Control Board in response to the first pulse. If only one pulse is present, connect oscilloscope to test point TP8 on Logic Board A1 (AY40-006S). If no pulse is present, OCP Serial Cable is faulty or not connected properly. Note: Verify jumpers A16JP1, A16JP4, A16JP10, and A16JP11 are installed on OCP Control Board. Using DMM, measure dc voltage at test point A1TP1. If less than +5 VDC, check for blown fuse F8 on Interface Board A9 (AY40-023T). Replace fuse if necessary.
		

Table 5-1. Error Messages and Possible Cause(s)

Error Message	Possible Cause(s)	Remedial Action
Generator Limit	PREP was pressed while a combination of the selected parameters is outside of the limits of the generator model or tube type.	1. Verify the KW (kV x mA) does not exceed the rating of the generator. 2. Verify the selected mAs does not exceed the rating of the generator. 3. Verify the tube can support the kV, mA, and/or time selected.
Generator Unhandled	The Error Code from the Generator Logic Board Master was not recognized.	1. Restart the System by cycling the rocker switch mounted to the Power/Expose Control Box. 2. If the error persists, contact Service Department.
Generator Not Ready	1. Generator entered Filament low voltage state due to no operator activity for over 60 minutes. 2. Failed communication between generator cabinet and operator control panel. 3. Wrong program loaded into OCP Control Board A16U3. 4. On stored energy (SE) generators, the batteries have not recharged to 400 VDC.	1. Press any key other than EXPOSE or PREP, then retry exposure. 2. Check that serial cable between OCP and generator cabinet is properly connected. 3. Verify correct microcontroller program has been loaded into OCP Control Board A16U3. 4. Allow batteries to re-charge.
Heat Alarm	Preempts exposure when setting will cause tube to overheat.	Allow system to cool until tube heat returns to allowable level.
Heat Limit	Preempts exposure when setting will cause tube to overheat.	Allow system to cool until tube heat returns to allowable level.
Hold Button	Exposure terminated prematurely because the EXPOSE or PREP key was released before exposure was completed.	Re-take exposure making sure EXPOSE/PREP key is pressed continuously throughout entire duration of exposure.
HSS Detected	A High Speed Starter has been detected when none is selected.	If High Speed starter is connected to generator, change setting in Service / Config / Rotor to a HSS setting ("QMI HSS" or "AID HSS").

Table 5-1. Error Messages and Possible Cause(s)

Error Message	Possible Cause(s)	Remedial Action
Invalid AEC Exposure Value	Improper AEC calibration.	Re-calibrate AEC.
Invalid AEC License	1. System is not configured with AEC option. 2. The AEC license is not active	1. Check AEC configuration settings are correct. 2. Call Technical Service/Support.
Invalid License - Invalid base license. System Key: {text string}	Invalid Q-Vision license. Note: {text string} will contain additional details.	Call Technical Service/Support.
Invalid License - File not found. System Key: {text string}	Q-Vision license file missing. Note: {text string} will contain additional details.	Call Technical Service/Support.
Invalid Boost Time Exposure Value	The database is corrupt.	Call Technical Service/Support.
Invalid Break Time Exposure Value	The database is corrupt.	Call Technical Service/Support.
Invalid Digital License	The Digital License is not active.	Call Technical Service/Support.

Table 5-1. Error Messages and Possible Cause(s)

Error Message	Possible Cause(s)	Remedial Action
Invalid Filament Exposure Value	Improper Calibration.	Re-calibrate filament.
Invalid Film Screen Selected	The Film Screen is not calibrated.	Calibrate selected Film Screen, or change Film Screen selection.
Invalid Generator button	1. Generator iButton is not installed. 2. Generator improperly read data from iButton.	1. Verify that iButton is installed 2. Restart the System by cycling the rocker switch mounted to the Power/Expose Control Box.
Invalid Generator Model License		Call Technical Service/Support.
Invalid HSS License	1. System is not configured with high-speed starter. 2. The HSS license is not active.	1. Check rotor configuration settings are correct. 2. Call Technical Service/Support.
Invalid Ion Chamber Selected	The AEC mode of operation is selected, while the NONE receptor is active.	Select the WALL or TABLE receptor.
Invalid KVP Exposure Value	Improper calibration.	Re-calibrate system.
Invalid MA Exposure Value	Improper calibration.	Re-calibrate system.
Invalid Receptor	1. Improper calibration. 2. Corrupt database.	Re-calibrate system.
Invalid Time Exposure Value	1. Improper calibration. 2. Corrupt database.	Re-calibrate system.

Table 5-1. Error Messages and Possible Cause(s)

Error Message	Possible Cause(s)	Remedial Action
Keybrd	Indicates a key on the Front Panel is stuck on.	1. Verify a switch on the keyboard was not accidentally depressed during power up. 2.Check connection between OCP Control Board A16A1 (AY40-004S1) and Front Panel Overlay (flat green cable). 3. Replace Front Panel. If front panel replacement doesn't correct problem, then replace OCP Control Board A16A1.
KVP Error	1. The anode and cathode KV are sufficiently different to cause an error. 2. The anode or cathode voltage sense is exceeding 15% of program voltage. 3. Non-Q-Connect Systems only: Communication between OCP Control Board A16 (AY40-004S1) and Logic Board A1 (AY40-006S) was interrupted. 4. Arc in system (H.V. Transformer, x-ray tube, or high-voltage cables). 5. Faulty/missing J1 connection on KVP Control Board A2 (AY40-003S). 6. Failure of +5V, +15V, -15V or +18V supply voltages.	1. On KVP Control Board A2 (AY40-003S), check the difference between the Anode (TP1) and Cathode (TP2) to determine if difference exists during an exposure. 2. If anode (A2TP1) or cathode (A2TP2) are above program voltage by 15% (1V=8.2 kVp), replace KVP Control Board A2. If problem persists, replace H.V. Transformer A17, x-ray tube, or high-voltage cables. 3. Refer to "Generator Comms" error message for troubleshooting and correcting communications problems. 4. Replace H.V. Transformer A17, x-ray tube, or high-voltage cables. 5. Check all connections on KVP Control Board A2. 6. Check voltages at A2TP8 (+5V) and A2TP9 (+18V). If not present, replace KVP Control Board A2. Check voltages at A2TP3 (+15V) and A2TP5 (-15V). If not present, replace Power Supply Board A6 (AY40-005T).

Table 5-1. Error Messages and Possible Cause(s)

Error Message	Possible Cause(s)	Remedial Action
KVP Volts	Indicates the exposure kVp voltage is out of range.	Call Technical Service/Support.
LBMast Micro	Logic Board master microprocessor A1U9 returned incorrect checksum.	Check A1U9. Call Technical Service/ Support.
LBSlave Micro	Logic Board slave microprocessor A1U10 returned incorrect checksum.	Check A1U10. Call Technical Service/Support.

Table 5-1. Error Messages and Possible Cause(s)

Error Message	Possible Cause(s)	Remedial Action
Line/400V Anode	Missing or incorrect anode sensing voltage (Vsense A) value returned.	1. Access Service Mode>Calibration>AD Calibration menu. Verify +400V Anode voltage is within tolerance per Table 3-8 (non-Q-Bus Systems) or Table B-3 (DiRex Systems) or Table D-1 (all other Q-Bus Systems). If not, calibrate in accordance with "A/D Calibration Procedure" in Chapter 3 (non-Q-Bus Systems) or Appendix B (DiRex Systems) or Appendix D (all other Q-Bus Systems). 2. The input voltage is not selected correctly at terminal block TB1 (refer to Chapter 2, Assembly & Installation for details). 3. Using a DMM, measure the dc voltage across the (+) and (-) terminals of the Anode DC capacitor bank (i.e., C13-C16 on non-stored energy (SE) systems, and C9-C11 on SE systems). The voltage should be between 355-440 VDC. If not, check for open fuses F1 and F2 (mounted on inside front edge of generator chassis). 4. If voltage across Anode DC capacitors is within range, measure voltage from (+) terminal to chassis ground, then from (-) terminal to ground. The measured voltage for each should be one-half the value measured in previous step. If not, check incoming line voltage at TB2 (TB1 on SE units).

Table 5-1. Error Messages and Possible Cause(s)

Error Message	Possible Cause(s)	Remedial Action
Line/400V Anode (Cont'd)		5. Disconnect J2 on Logic Board A1 (AY40-006S). Using DMM, measure voltage across A1J2-1 (V_{SENSE} signal) and A1J2-3 (ground). Voltage should be 0.01 times the voltage across Anode DC capacitor bank (±3%). If not, check voltage at U1-7 on Line Monitor Board A8 (AY40-022T). 6. If this voltage is also out of range (i.e., not equal to 0.01 times the voltage across the Anode DC capacitor bank (±5%)), replace the Line Monitor Board. 7. If the voltage at A8U2-7 is within range, plug in A1J2 and check the voltage at A1U14-33 (SLAVE microprocessor), The voltage should be 0.01 times the voltage across the Anode DC capacitor bank (±5%). If the voltage is within range, replace A1U14. If out of range, replace the Line Monitor Board. 8. Rectifier DB1 (and/or DB2 on two-power module systems) is damaged. 9. On SE units, the Line Monitor/ Source Charger board (AY40-028T) is not working properly.

Table 5-1. Error Messages and Possible Cause(s)

Error Message	Possible Cause(s)	Remedial Action
Line/400V Cathode	Missing or incorrect cathode sensing voltage (Vsense C) value returned.	1. Access Service Mode>Calibration>AD Calibration menu. Verify +400V Cathode voltage is within tolerance per Table 3-8 (non-Q-Bus Systems) or Table B-3 (DiRex Systems) or Table D-1 (all other Q-Bus Systems). If not, calibrate in accordance with "A/D Calibration Procedure" in Chapter 3 (non-Q-Bus Systems) or Appendix B (DiRex Systems) or Appendix D (all other Q-Bus Systems). 2. Using a DMM, measure the dc voltage across the (+) and (-) terminals of the Cathode DC capacitor bank (i.e., C9-C12 on non-stored energy (SE) systems, and C9-C11 on SE systems). The voltage should be between 355-440 VDC. If not, check for open fuses F1 and F2 (mounted on inside front edge of generator chassis). 3. If voltage across Cathode DC capacitors is within range, measure the voltage from the (+) terminal to chassis ground and then from the (-) terminal to ground. The measured voltage for each should be one-half the value measured in the previous step. If not, check incoming line voltage at TB2 (TB1 on SE units).

Table 5-1. Error Messages and Possible Cause(s)

Error Message	Possible Cause(s)	Remedial Action
Line/400V Cathode (Cont'd)		4. Disconnect J2 on Logic Board A1 (AY40-006S). Using a DMM, measure the voltage at A1J2-2 (V_{SENSE} signal) and A1J2-3 (ground). The voltage should be 0.01 times the voltage across the Cathode DC capacitor bank (±3%). If not, check the voltage at U2-7 on Line Monitor Board A8 (AY40-022T). 5. If this voltage is also out of range (i.e., not equal to 0.01 times the voltage across the Cathode DC capacitor bank (±5% for single phase units, ±10% for three-phase units)), replace the Line Monitor Board. 6. If the voltage at A8U2-7 is within range, plug in A1J2 and check the voltage at A1U14-34 (SLAVE Microprocessor), The voltage should be 0.01 times the voltage across the Cathode DC capacitor bank (±5% for single phase units, ±10% for three-phase units). If the voltage is within range, replace A1U14. If out of range, replace the Line Monitor Board. 7. Rectifier DB1 (and/or DB2 on two-power module systems) is damaged. 8. On SE units, the voltage on second battery tray is not charging properly, and therefore, the voltage is out of range.
Load Configuration	Cable connections with Generator check out, but configuration data is corrupt.	1. Power Generator OFF then ON. 2. Use Backup Configuration.
Long Prep	PREP time exceeded the eighteen-seconds limit.	Press any key on the Operator Control Panel to clear warning message. Re-take exposure.

Table 5-1. Error Messages and Possible Cause(s)

Error Message	Possible Cause(s)	Remedial Action
Lost Expose	Exposure sequence disabled due to missing EXPOSE hardware line or the EXPOSE switch was lifted during an exposure.	1. Verify the EXPOSE switch remains pressed throughout entire exposure. 2. On Logic Board A1 (AY40-006S), monitor U4 pin 2 to determine if the expose signal is present during expose (should stay active low during exposure cycle). If not, replace Logic Board. 3. Replace KVP Control Board A2 (AY40-003S).
Lost Prep	Exposure sequence disabled due to missing PREP hardware line or PREP signal interruption during PREP cycle.	1. Verify PREP button remains depressed during entire PREP cycle. 2. On Logic Board A1 (AY40-006S) test point TP4, check for less than 1 V during PREP and Exposure. If not, replace OCP Control Board A16A1 (AY40-004S1). 3. If problem persists, then replace Logic Board A1 (AY40-006S).

Table 5-1. Error Messages and Possible Cause(s)

Error Message	Possible Cause(s)	Remedial Action
MA Current	Indicates the exposure mA current is out of range.	1. Verify that generator is properly calibrated. 2. Check if current on standby is approximately 2.5 amps. If not, replace KVP Control Board A2 (AY40-003S). If problem persists, replace Filament Control Board A5 (AY40-007T). Replace Logic Board A1 (AY40-006S) if problem is still not corrected. 3. On KVP Control Board A2, connect oscilloscope probe to test point A2TP7 to verify correct tube current waveform. The current waveform should indicate 1V/100 mA. If waveform is close to mA setting, re-calibrate generator. If waveform is zero, replace KVP Control Board A2. If problem persists, replace H.V. Transformer A17 (AY20-031 on 125 kVp system, or AY20-032 on 150 kVp system).

Table 5-1. Error Messages and Possible Cause(s)

Error Message	Possible Cause(s)	Remedial Action
Minus 15V	Missing or incorrect -15 VDC supply voltage.	1. Access Service Mode>Calibration>AD Calibration menu. Verify -15VDC voltage is within tolerance per Table 3-8. If not, calibrate in accordance with "A/D Calibration Procedure" in Chapter 3. 2. Check for -15 VDC (±10%) on Power Supply Board A6 (AY40-005T) test point TP5. If 0 VDC, check fuse F2 on Interface Board A9 (AY40-023T). If F2 is open, replace fuse. If there still is no -15 VDC at A6TP5, replace Power Supply Board. 3. If voltage at A6TP5 is not 0 VDC, but is too low, check if another board is shorting the -15 VDC output. Disconnect output cable A6J2 and measure voltage at A6TP5. If within range, check other boards for shorts. If not within range, replace Power Supply Board.
Model Limits	PREP was pressed while a combination of the selected parameters is outside of the limits of the generator model or tube type.	1. Verify the KW (kV x mA) does not exceed the rating of the generator. 2. Verify the selected mAs does not exceed the rating of the generator. 3. Verify the tube can support the kV, mA, and/or time selected.
No AEC Field Selected	AEC operating mode is selected, but no AEC Field is Selected.	Select the appropriate AEC Field(s) for the examination.

Table 5-1. Error Messages and Possible Cause(s)

Error Message	Possible Cause(s)	Remedial Action
No HSS Connected	No High Speed Starter detected when selected	1. If system is non-high speed starter configuration (i.e., no high speed starter is installed), verify the rotor selected in the Service/Config/ Rotor is not set to "AID HSS" or "QMI HSS". If so, change to correct setting. 2. Verify High Speed Starter is properly connected. If equipped with QMI internal high speed starter, verify following connections are good: • J2-8 on HSS Control Board A20A1 (AY40-035S) and J8-8 on Logic Board A1 (AY40-006S) • J2-9 on HSS Control Board A20A1 and J8-9 on Logic Board A1
No HV	High-Voltage transformer or Power Module not functioning properly.	Call Technical Service/Support.
No Universal Equipped	AUX receptor selected, but Generator is not equipped with Universal Option.	Select the WALL or TABLE receptor or NONE.
Not Rotating	*Systems without a high-speed starter*:	

Table 5-1. Error Messages and Possible Cause(s)

Error Message	Possible Cause(s)	Remedial Action
	Tube rotor or generator rotor drive not functioning properly.	1. Check boost and run voltages: Connect DVM across Rotor Drive Board A10 (AY40-013T) terminals TB1-1 and TB1-3. Press PREP. Boost voltage should read 183-227 or 110-130 VAC, run voltage should read 54-66 VAC. If not, check for open fuse F7 on Interface Board A9 AY40-023T (or AY40-034T). If F7 is good, replace Rotor Drive Board A10. 2. Check for correct adjustment of Rotor Drive Board A10 potentiometers R20 and R24 as described in in the "Rotor Drive Board A10 (AY40-013T) Adjustment procedure in Chapter 2, ASSEMBLY & INSTALLATION.
Not Rotating	*Systems equipped with AID External High-Speed Starter*:	
	Tube rotor or high-speed starter (HSS) unit not functioning properly.	1. Remove HSS cover and check error code display for error indication. Refer to HSS manufacturer's documentation for error analysis instructions. 2. Verify jumper JP6 is installed on Logic Board A1 (AY40-006S). 3. Check rotor cable connection between tube and high speed starter unit.

Table 5-1. Error Messages and Possible Cause(s)

Error Message	Possible Cause(s)	Remedial Action
Not Rotating		
	Systems equipped with a QMI Internal High-Speed Starter:	
	1. Wrong system configuration.	1. Access the Service Menu>Configuration screen and set the Rotor Type to "QMI HSS". Check if jumper JP1 on HSS Driver Board A20A2 (AY40-036S) is installed. If not, install it.
	2. Faulty HSS Control Board A20A1 (AY40-035S).	2. Using oscilloscope, observe the following signals on HSS Control Board A20A1 (AY40-035S) (Note: Synchronize the trigger on CH1 when it is falling.): • CH1 - connect to U7-16 and GND • CH2 - connect to TP19 and GND • CH3 - connect to TP14 and GND Press PREP. Verify during PREP the signal on TP19 is 0 Volts (low) and TP14 is oscillating all the time. If TP19 is oscillating, replace HSS Control Board A20A1.

Table 5-1. Error Messages and Possible Cause(s)

Error Message	Possible Cause(s)	Remedial Action
Not Rotating (Cont'd)	3. Blown Fuse and/or IGBT on HSS Driver Board A20A2 (AY40-036S).	3. Verify blown fuse as follows: a. Power off the Generator. **WARNING!** Wait at least five minutes for capacitors to discharge. Verify voltage is discharged. b. **Unplug TB1 on HSS Driver Board A20A2 (AY40-036S).** c. Using ohmmeter, check if fuses F1, F3 and F4 are open. If a fuse is blown, do the following: a. On HSS Control Board A20A1 (AY40-035S), short TP19 to TP1. b. Connect oscilloscope leads to the following test points on HSS Driver Board A20A2: U4-7 and TP16 U1-7 and TP17 U5-7 and TP16 U3-7 and TP18 c. Turn on the generator. Press PREP and capture waveforms on the oscilloscope. d. The gate pulses should be between 12-14 volts on each channel. If not, replace HSS Driver Board A20A2 (AY40-036S). Otherwise, replace blown fuse(s).

Table 5-1. Error Messages and Possible Cause(s)

Error Message	Possible Cause(s)	Remedial Action
Not Rotating (Cont'd)	4. Faulty connection between HSS Control Board A20A1 (AY40-035S) and HSS Driver Board A20A2 (AY40-036S).	4. Verify following cable connections are good: a. AY51-146 check: On HSS Driver Board A20A2 (AY40-036S), connect oscilloscope leads between test points TP1 and TP10 and between TP5 and TP10. Press PREP and check the signals. If there are no signals, check the AY51-146 cable connection between J3 on HSS Control Board A20A1 and J1 on HSS Driver Board A20A1. If signals are present and cable is good, replace HSS Control Board A20A1. b. AY51-131 check: Verify AY51-131 cable between J5 on HSS Control Board A20A1 and J4 on HSS Driver Board A20A2 is good and connectors are properly seated. c. AY51-130 check: Verify AY51-130 cable between J4 on HSS Control Board A20A1 and J2 on HSS Driver Board A20A2 is good and connectors are properly seated.
	5. Faulty/improper connection at HSS Driver Board A20A2 (AY40-036S) TB1.	5. Verify connection of AC voltages on A20A2TB1 matches the Tube Type used (refer to Chapter 2, ASSEMBLY & INSTALLATION for correct configuration). Check TB1 plug to ensure it is properly seated.
	6. Faulty connection between HSS Driver Board A20A2 (AY40-036S) and Tube Rotor.	6. Verify wiring between TB4 on HSS Driver Board A20A2 and Tube Rotor is good. Correct if necessary.

Table 5-1. Error Messages and Possible Cause(s)

Error Message	Possible Cause(s)	Remedial Action
Not Rotating (Cont'd)	7. Faulty connection between HSS Driver Board A20A2 (AY40-036S) and Rotor Phase Capacitors. 8. Incorrect Rotor Phase Capacitor configuration for x-ray tube.	7. Verify wiring between TB3 on HSS Driver Board A20A2 and Phase Capacitors is good. Correct if necessary. 8. Verify Rotor Phase Capacitor configuration is correct (refer to Chapter 2, Assembly & Installation).
NVRam	Non-volatile random access memory (NVRAM) returned incorrect checksum.	Check A16U17. Call Technical Service/Support.
OCP Micro	Non-Q-Connect Systems only: Operator Control Panel microprocessor (A16U3) returned incorrect checksum.	Check A16U3. Call Technical Service/Support.
Phase Missing	Hardware has detected that at least one phase of a three-phase generator is not present.	1. Check the connections to AutoTransformer T1 (settings are at terminal block TB2). 2. Verify the phases are available from the utility service by measuring with volt-meter. 3. If above are satisfactory, replace Line Monitor Board A8 (AY40-022T2).
Please Wait	Exposure attempted while System was not ready (no READY Icon displayed).	Allow more time for System to reach its ready state (READY icon displayed on Overlay). Note: Maximum of two high-speed starts per minute are permitted.

Table 5-1. Error Messages and Possible Cause(s)

Error Message	Possible Cause(s)	Remedial Action
Plus 15V	Missing or incorrect +15 VDC supply voltage.	1. Access Service Mode>Calibration>AD Calibration menu. Verify +15 VDC voltage is within tolerance per Table 3-8. If not, calibrate in accordance with "A/D Calibration Procedure" in Chapter 3. 2. Check for +15 VDC (±10%) on Power Supply Board A6 (AY40-005T) test point TP10. If 0 VDC, check fuse F3 on Interface Board A9 (AY40-023T). If F3 is open, replace fuse. If there still is no +15 VDC at A6TP10, replace Power Supply Board. 3. If voltage at A6TP10 is not 0 VDC, but is too low, check if another board is shorting the +15 VDC output. Disconnect output cable A6J2 and measure voltage at A6TP10. If within range, check other boards for shorts. If not within range, replace Power Supply Board.
Plus 24V	Missing or incorrect +24 VDC supply voltage.	1. Access Service Mode>Calibration>AD Calibration menu. Verify +24 VDC voltage is within tolerance per Table 3-8. If not, calibrate in accordance with "A/D Calibration Procedure" in Chapter 3. 2. Check for +24 VDC (±10%) on Power Supply Board A6 (AY40-005T) test point TP8. If 0 VDC, check fuse F4 on Interface Board A9 (AY40-023T). If F4 is open, replace fuse. If there still is no +24 VDC at A6TP8, replace Power Supply Board.

Table 5-1. Error Messages and Possible Cause(s)

Error Message	Possible Cause(s)	Remedial Action
Plus 24V (Cont'd)		3. If voltage at A6TP8 is not 0 VDC, but is too low, check if another board is shorting the +24 VDC output. Disconnect output cable A6J2 and measure voltage at A6TP8. If within range, check other boards for shorts. If not within range, replace Power Supply Board.
Plus 5V	Missing or incorrect +5 VDC supply voltage.	1. Access Service Mode>Calibration>AD Calibration menu. Verify +5 VDC voltage is within tolerance per Table 3-8. If not, calibrate in accordance with "A/D Calibration Procedure" in Chapter 3. 2. Check for +5 VDC (±10%) on Power Supply Board A6 (AY40-005T) test point TP1. If 0 VDC, check fuse F8 on Interface Board A9 (AY40-023T). If F8 is open, replace fuse. If there still is no +5 VDC at A6TP1, replace Power Supply Board. 3. If voltage at A6TP1 is not 0 VDC, but is too low, check if another board is shorting the +5 VDC output. Disconnect output cable A6J2 and measure voltage at A6TP1. If within range, check other boards for shorts. If not within range, replace Logic Board A1 (AY40-006S).
Prep WDT	Exposure sequence disabled due to loss of communication with PREP watchdog timer.	Call Technical Service/Support.

Table 5-1. Error Messages and Possible Cause(s)

Error Message	Possible Cause(s)	Remedial Action
Receptor Not Ready	The signal on the Receptor Ready terminal of the Digital Interface Board A9 (AY40-034T) is not ready within 500 ms from the time PREP was initiated. This can be caused by: 1. PREP was initiated before the DR system could complete the image acquisition and processing cycle of the previously acquired image. 2. The DR system has malfunctioned. 3. The Digital Interface Board A9 (AY40-034T) has malfunctioned.	1. Wait until image acquisition and processing cycle is complete before attempting to re-expose. 2. Verify the digital receptor (DR) system is properly connected and is operating normally. 3. Replace the Digital Interface Board A9 (AY40-034T).
Rotor Current	(Note: This error is only applicable with QMI High-Speed Starter equipped systems) 1. Incorrect/no reference voltage on Control Board. 2. Incorrect overvoltage adjustment. 3. Faulty connection between HSS Driver Board A20A2 (AY40-036S) and Tube Rotor.	1. On HSS Control Board A20A1 (AY40-035S), measure voltage between test points TP17 and TP1(GND). Voltage measurement should read +5.00 ±0.02 VDC. If not, replace HSS Control Board A20A1. 2. On HSS Control Board A20A1 (AY40-035S), connect DVM between U20-7 and TP1(GND). Adjust potentiometer R48 for voltage measurement of 2.8 - 3.0 volts for small tubes (3") and 4.5 for large tubes (4"). If proper adjustment cannot be achieved, replace HSS Control Board A20A1 (AY40-035S). If voltage is still incorrect, replace tube. 3. Verify wiring between TB2 and TB4 on HSS Driver Board A20A2 and Tube Rotor is good. Correct if necessary.

Table 5-1. Error Messages and Possible Cause(s)

Error Message	Possible Cause(s)	Remedial Action
Rotor Current (Cont'd)	4. Faulty connection between HSS Driver Board A20A2 (AY40-036S) and Rotor Phase Capacitors.	4. Verify wiring between TB3 on HSS Driver Board A20A2 and Phase Capacitors is good. Correct if necessary.
Rotor Overrun	Tube has been rotating for longer than 30 continuous seconds.	Set OCP power on/standby switch to standby; set ON/OFF circuit breaker on generator cabinet to OFF. Call Technical Service/Support.
Rotor Temp	Tube rotor is too hot. Tube thermal switch is activated.	
	Systems equipped with a Standard Rotor (Non-High-Speed Starter):	
		1. Check if the tube's temperature switch is open. If so, allow tube to cool for approximately 15-30 minutes. 2. After cooling, press PREP. If the error recurs, check the wiring from the tube to Rotor Drive Board A10 (AY40-013T), In particular, check connections to A10TB1-6 and A10TB1-7. 3. Connect a jumper wire between A10TB1-6 and A10TB1-7 and press PREP. If Rotor Temp error does not appear, check the rotor cable. 4. Check the temperature switch in the tube. The switch should be N.C. 5. Connect DMM to A10TP9. This test point should be logic low. If not, jumper this test point to ground and check if error message does not repeat. If it re-occurs, check connection A10J3-3 (orange wire) to Logic Board A1 connector J10-3. If this is good, replace the Logic Board.

Table 5-1. Error Messages and Possible Cause(s)

Error Message	Possible Cause(s)	Remedial Action
Rotor Temp (Cont'd)	*Systems equipped with a QMI Internal High-Speed Starter*:	
		1. Check if the tube's temperature switch is open. If so, allow tube to cool for approximately 15-30 minutes. 2. After cooling, press PREP. If the error recurs, proceed with next step. 3. Turn off generator. 4. On HSS Driver Board A20A2 (AY40-036S), measure resistance between TB4-1 and TB4-2. If approximately 0 ohms, skip to step 6. If high impedance, wait 15-30 minutes until temperature of tube drops sufficiently. 5. If after cooling the problem persists, check the wiring connection between TB4 and the tube rotor temperature switch. If the connection is correct, verify tube thermal switch operation. 6. If wiring and tube thermal switch are good, check resistance across F5. If approximately 0 ohms, go to next step, otherwise change the fuse and check wiring connection between tube and terminal blocks TB2 and TB4. 7. Check the wiring connection between J4 on HSS Control Board A20A1 (AY40-035S) and J2 on HSS Driver Board A20A2 (AY40-036S) and the connection between J2 on HSS Control Board A20A1 and J8 on Logic Board A1 (AY40-006S). If connections are good, call for Technical Service/Support.

Table 5-1. Error Messages and Possible Cause(s)

Error Message	Possible Cause(s)	Remedial Action
Save Configura-tion	Cable connections to Generator check out, but configuration data is corrupt.	1. Power Generator OFF then ON. 2. Use Backup Configuration.
Stuck But-ton	Button down at power-up.	1. Take finger off button 2. Check keyboard buttons for proper operation.

Table 5-1. Error Messages and Possible Cause(s)

Error Message	Possible Cause(s)	Remedial Action
Table Bucky	The table bucky has been selected but did not return the ready signal to start exposure. (This may take up to five seconds after exposure is requested.)	1. Verify the following did not occur: The "TABLE" receptor key on the OCP was selected on a system not equipped with a table receptor. 2. Check the bucky cable connections at both ends (i.e., Interface Board A9 (AY40-023T or AY40-034T) terminal block TB3 and the table bucky). Refer to bucky interconnection diagrams contained in Chapter 6, DIAGRAMS for proper wire connections. 3. On Interface Board A9, verify 120 VAC bucky power fuse F11 (2A, 250V slow-blow) is not open. 4. On Interface Board A9, check if switch SW1 is in correct position ("M" position if table is equipped with Midwest bucky, non-"M" position for all other type buckies). 5. Verify fuse in bucky is not open. Recycle bucky power by turning generator off, then on. If error still occurs, replace bucky control board. 6. On Logic Board A1 (AY40-006S), check for an active low signal at J4-4 during expose. If not present, replace Logic Board (including firmware). If present, check cable connection between Interface Board A9J6 and Logic Board A1J4. If connection is good, replace Interface Board.
Tube Limits	Backup time was reached based on current AEC technique factors exceeding exposure tube limits.	1. Modify technique factor(s) (e.g., reduce kVp). Re-take exposure. 2. Verify ion chamber cable connections are correct and secure.

Table 5-1. Error Messages and Possible Cause(s)

Error Message	Possible Cause(s)	Remedial Action
Uncalibrated Film Screen Selected	Film Screen never calibrated, or calibration data corrupt	Calibrate in accordance with instructions provided in Chapter 3 (non-Q-Bus Systems) or Appendix B (DiRex Systems) or Appendix D (all other Q-Bus Systems).
Unhandled Exception	An unknown error occurred.	Call Technical Service/Support.
V24 Brake	Missing or incorrect +24 VDC supply voltage (supplies voltage for operation of external equipment, e.g., tube stand, wall stand, etc.).	1. Access Service Mode>Calibration>AD Calibration menu. Verify +24V brake voltage is within tolerance per Table 3-8. If not, calibrate in accordance with "A/D Calibration Procedure" in Chapter 3. 2. Check for +24 VDC at TB7 on Interface Board A9 (AY40-023T). 3. Check fuse F9 on Interface Board A9. 4. If the above actions do not correct problem, replace Line Monitor Board A8.
Vref+	Missing or incorrect positive voltage reference (Vref+) value returned.	Call Technical Service/Support.
Vref-	Missing or incorrect positive voltage reference (Vref-) value returned.	Call Technical Service/Support.

Table 5-1. Error Messages and Possible Cause(s)

Error Message	Possible Cause(s)	Remedial Action
Wall Bucky	The wall bucky has been selected but did not return the READY signal to start exposure. (This may take up to five seconds after exposure is requested.)	1. Verify the following did not occur: The "WALL" receptor key on the OCP was selected on a system not equipped with a wall receptor. 2. Check the bucky cable connections at both ends (i.e., Interface Board A9 (AY40-023T or AY40-034T) terminal block TB4 and the table bucky). Refer to bucky interconnection diagrams contained in Chapter 6, DIAGRAMS for proper wire connections. 3. On Interface Board A9 (AY40-023T or AY40-034T), verify 120 VAC bucky power fuse F12 (2A, 250V slow-blow) is not open. 4. On Interface Board A9, check if switch SW1 is in correct position ("M" position if wall stand is equipped with Midwest bucky, non-"M" position for all other type buckies). 5.Verify fuse in bucky is not open. Recycle bucky power by turning generator off, then on. If error still occurs, replace bucky control board. 6. On Logic Board A1 (AY40-006S), check for an active low signal at J4-5 during expose. If not present, replace Logic Board (including firmware). If present, check cable connection between Interface Board A9J6 and Logic Board A1J4. If connection is good, replace Interface Board.
Warning - Using default APR tree	Occurs in conjunction with "APR Tree Load Error".	Because of a load error the default APR tree will be used. This WILL NOT overwrite the current APR tree if it exists. You will get this message until you fix the tree. Load APR editor and fix the tree.

Table 5-1. Error Messages and Possible Cause(s)

Error Message	Possible Cause(s)	Remedial Action
Warning - Using default configuration	Occurs in conjunction with "Configuration Load Error".	Because of a load error the default configration will be used. This overwrites the current configuration, if one exists.

Optional +28 VDC Power Supply Troubleshooting

The following steps apply only to systems equipped with the internally-mounted +28 VDC Power Supply Option (QG-28VPS). The QG-28VPS provides a regulated +28 VDC output source to power peripheral x-ray equipment such as tube stands, wall stands, etc. If a problem with the power supply is suspected, proceed as follows:

1. Disconnect Power Supply QG-28VPS output wires at pins P2-1 and P2-2.
2. With the generator power turned on, measure the DC output across Power Supply QG-28VPS pins P2-1 and P2-2. It should measure between +26.5 and +27.5 VDC on systems intended for use with Quantum QW-420-T/-D wall stand, and between +29.5 and +30.5 VDC on systems intended for use with RS-580 Overhead Tube Crane. Adjust voltage output if necessary using potentiometer on power supply.
3. If no output exists at terminals P2-1 and P2-2, verify 220 VAC input to power supply at terminals P1-L and P1-N. If 220 VAC is present, replace power supply.
4. If no 220 VAC at power supply input, check for open Fuse F7 on Interface Board A9 (AY40-061T used on non-digital systems/ AY40-062T used on digital systems).

SERVICE REPORTS

The HF Series X-ray Generator provides a variety of service reports to assist the Service Technician in maintaining the proper operation of the system, and to help troubleshoot problems when they occur.

The way in which Service Reports is accessed and the appearance of the Service Reports screens differ depending on the operator control panel configuration of the HF Series X-ray generator. There are three operator control panel configurations:

- ODYSSEY operator control panel
- Q-VISION operator control panel
- Workstation-based operator control panel (generator is integrated with either a digital radiography (DR) or computed radiography (CR) system)

Refer to the appropriate section that follows depending on the type operator control panel your system uses.

Accessing Service Reports - ODYSSEY X-ray Generators

The following instructions apply to ODYSSEY HF Series™ X-ray Generator systems. Service Reports are accessed as follows:

1. Set the ON/OFF circuit breaker CB1 on the generator cabinet to ON position.
2. Set the power on/standby switch on the Operator Control Panel (OCP) to the standby (⏻) position, then to the on (⊙) position.
3. The system begins the start up sequence ("Quantum Medical Imaging" is displayed and "Testing. Standby." is flashing). (See Figure 5-1.)
4. Within five seconds of start up, press the upper left field select key to access the Password menu.
5. In the Password menu, enter the default Service/Support Technician password (58623) using the field select keys next to the corresponding numbers.

6. Upon validation of the password, the Service Mode Menu displays. Press the key next to the **Reports** field. The Service Reports Menu displays:

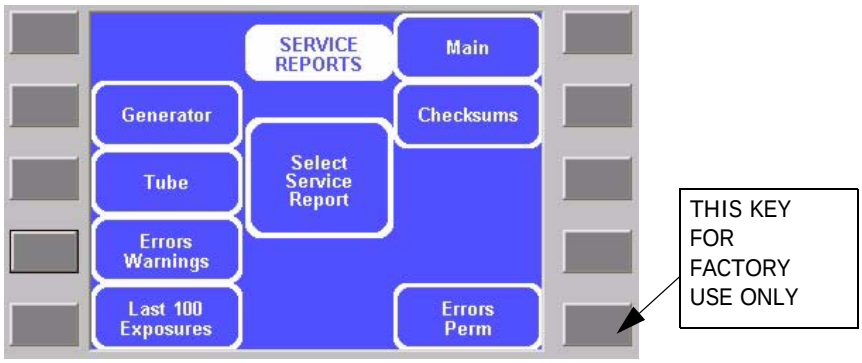


Figure 5-1. Service Reports Menu

The Service Reports Menu provides access to various types of system information. The following briefly describes the various Service Report Menu selections:

- **Generator** Report: Provides total exposure count, average kV and mA exposure settings, and the total time of all exposures taken on generator.
- **Last 100 Exposures** Report: Provides a chronological listing of the last 100 exposures. Each exposure (event) can be viewed showing the time and date the exposure occurred, and the exposure settings (i.e., kVp, mA, time, AEC on/off status, and receptor selected). The **Next Error** and **Previous Error** keys are used to "scroll" up or down through the exposure report.
- **Tube** Report: Provides total exposure count, average kV and mA exposure settings, and the total time of all exposures taken on currently installed x-ray tube.
- **Errors & Warnings** Report: Provides a chronological listing of up to 100 error and/or warning messages. Each error or warning message (event) can be viewed showing the event name, the time and date the event occurred, and the exposure settings at the time the event occurred. The **Next Error** and **Previous Error** keys are used to "scroll" up or down through the exposure report.
- **Diagnostic**: Not functional at time this manual was printed.
- **Checksums**: Displays the software revision levels and checksums of OCP Control Board A16A1 (AY40-004S1) Microcontroller U3 (referred to as "Internal" program) and Flash Memory U2 ("External" program and "Database").

To select a report, press the key next to the report you want to view. Otherwise, press the key next to the **Main** field to return to the main Service Menu (see Figure 3-3).

The following paragraphs provide detailed descriptions of each of the various report screen selections.

Generator Reports

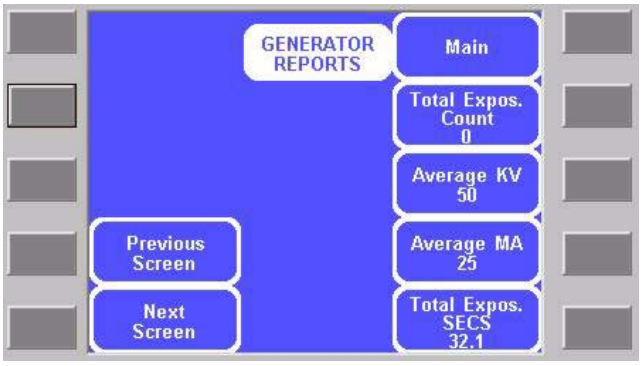


Figure 5-2. Generator Reports Screen

The Generator Reports screen, shown above, provides the following information:

- **Total Exposure (Expos.) Count** - Indicates total number of exposures taken on generator
- **Average (Aver.) KV** - Indicates mean KV value averaged over the total exposures taken on generator
- **Average (Aver.) MA** - Indicates mean mA value averaged over the total exposures taken on generator
- **Total Expos. TIME** - Indicates sum of exposure times (in seconds) of all exposures taken on generator

Tube Reports

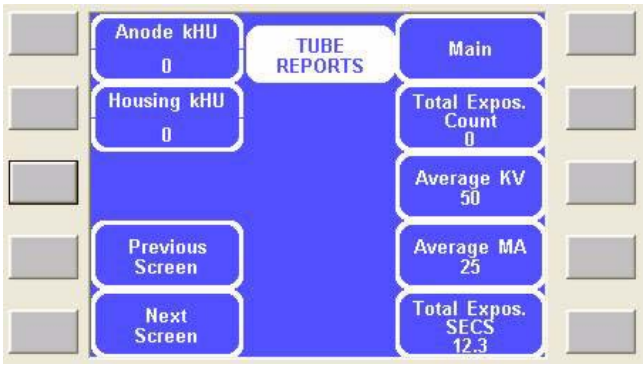


Figure 5-3. Tube Reports Screen

The Tube Reports screen, shown above, provides the following information:

- **Total Exposure Count** - Indicates total number of exposures taken with currently installed x-ray tube
- **Average (Aver.) KV** - Indicates mean KV value averaged over the total exposures taken with currently installed x-ray tube
- **Average (Aver.) MA** - Indicates mean mA value averaged over the total exposures taken with currently installed x-ray tube
- **Total Expos. SECS** - Indicates sum of exposure times (in seconds) of all exposures taken with currently installed x-ray tube

Events / Warnings Reports

Figure 5-4. Event Reports Screen

The Event Report screen, shown above, displays the most recent error or warning event that occurred on the system. The "event type" is displayed as shown in Figure 5-4 above, along with the exposure factors, time and date the event occurred. Pressing the key adjacent to the **Previous Error** field displays the Event Report of the event that occurred prior to the one currently displayed. Pressing the key adjacent to the **Next Error** field displays the Event Report of the error that occurred after the one currently displayed (i.e., the next most recent event). To return back to the main Service Menu, press the key next to **Main** field. The system retains up to 100 of the most recent Event Reports.

Service Checksum Report

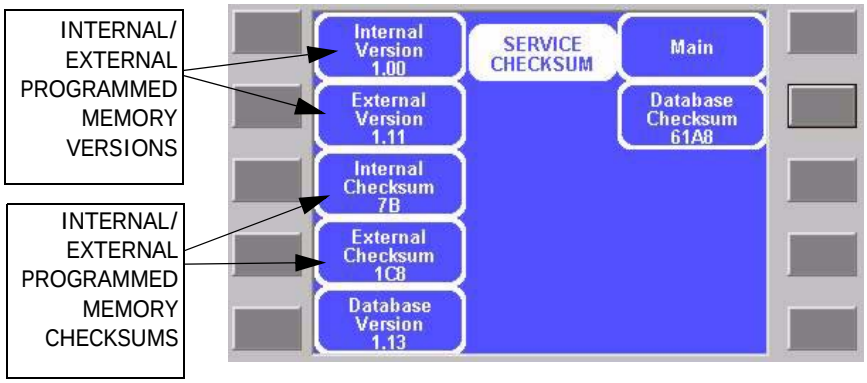


Figure 5-5. Service Checksum Report Screen

The Service Checksum Report screen, shown above, lists the software revision levels and checksum values for the various programmed devices used in the generator and for the database loaded into OCP Data Memory. The OCP Microcontroller Board A16A1 contains flash memory that is loaded with the indicated versions (and checksums) of internal and external programs (in addition to that in the microcontroller) and databases.

To return to the main Service Menu, press the key next to **Main** field.

Accessing Service Reports - Q-VISION Operator Control Panel

The following instructions apply to generators utilizing a Q-VISION operator control panel (OCP). The two types of service reports/utilities available on systems equipped with a Q-VISION OCP are:

- Statistics Report
- Error Log Viewer utility

Below is a description of how each is accessed, and what information is provided in each report.

Statistics Report

1. To gain access to the Generator Service programs, touch the Help button located on the lower right corner of the Q-VISION screen (shown on right). The Generator Help Services Screen (Figure 5-5a) appears:

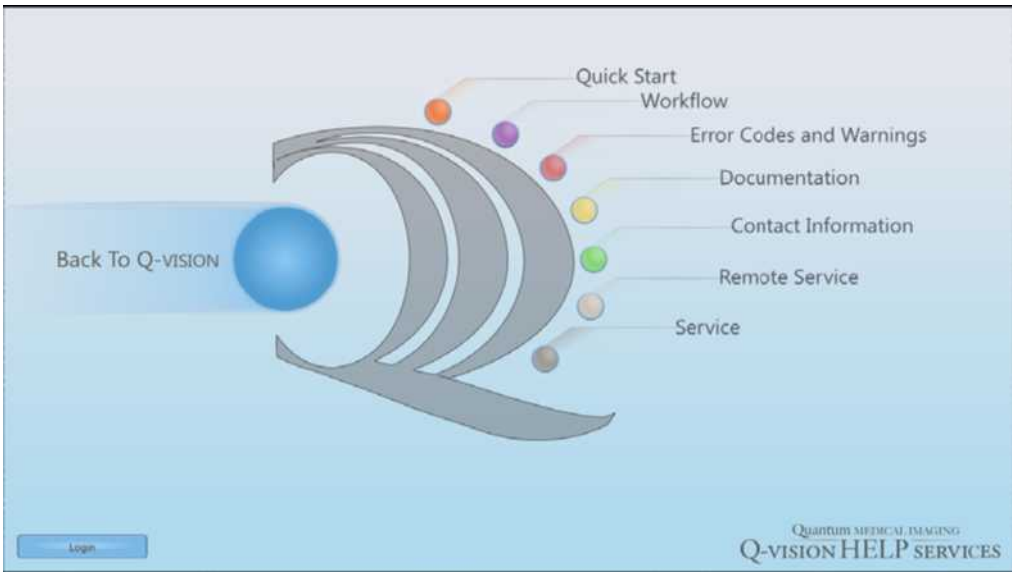


Figure 5-5a. Generator Help Services Screen

2. Touch the Login button at the lower left corner of the screen. A password entry keypad displays.

Figure 5-5b. Enter Password Screen

3. In the Enter Password screen, enter the default Service Technician password (58623) using the keypad, then select **Enter**. The word "Login" is replaced with "FieldTech" on the Generator Help Services screen to indicate successful login.

4. On the Generator Help Services screen, select **Service** option. The General Service Options Menu appears:

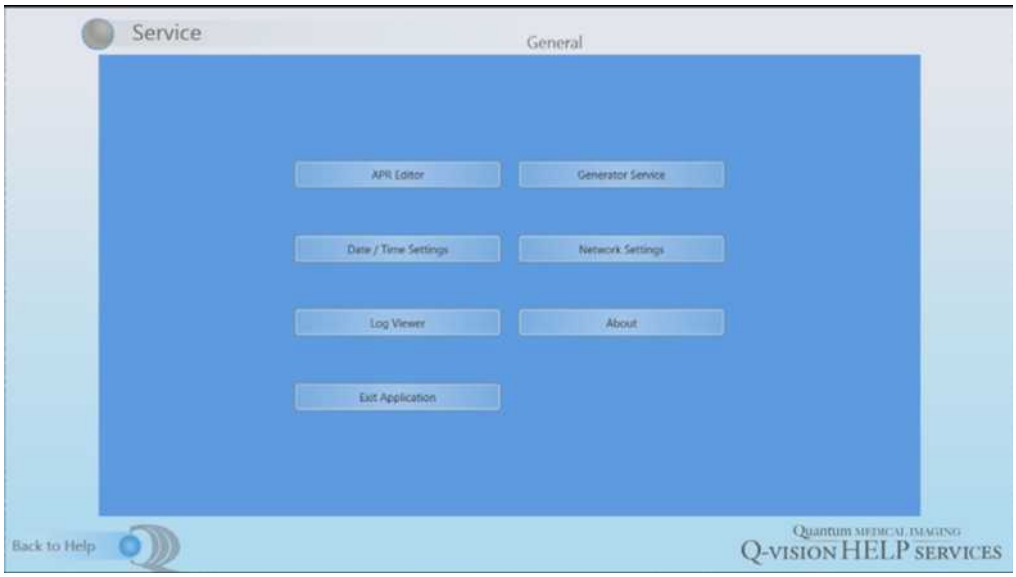


Figure 5-5c. General Service Options Menu

5. Select **Generator Service**. The following screen appears:

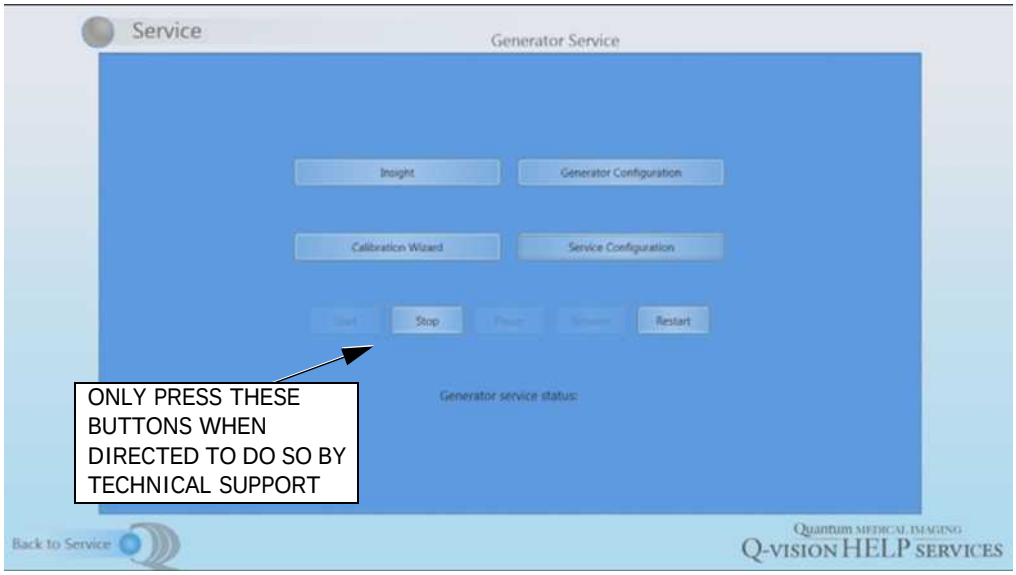


Figure 5-5d. Generator Service Options Menu

6. Select the **Insight** utility option. The "Insight" Service Utility Menu displays:

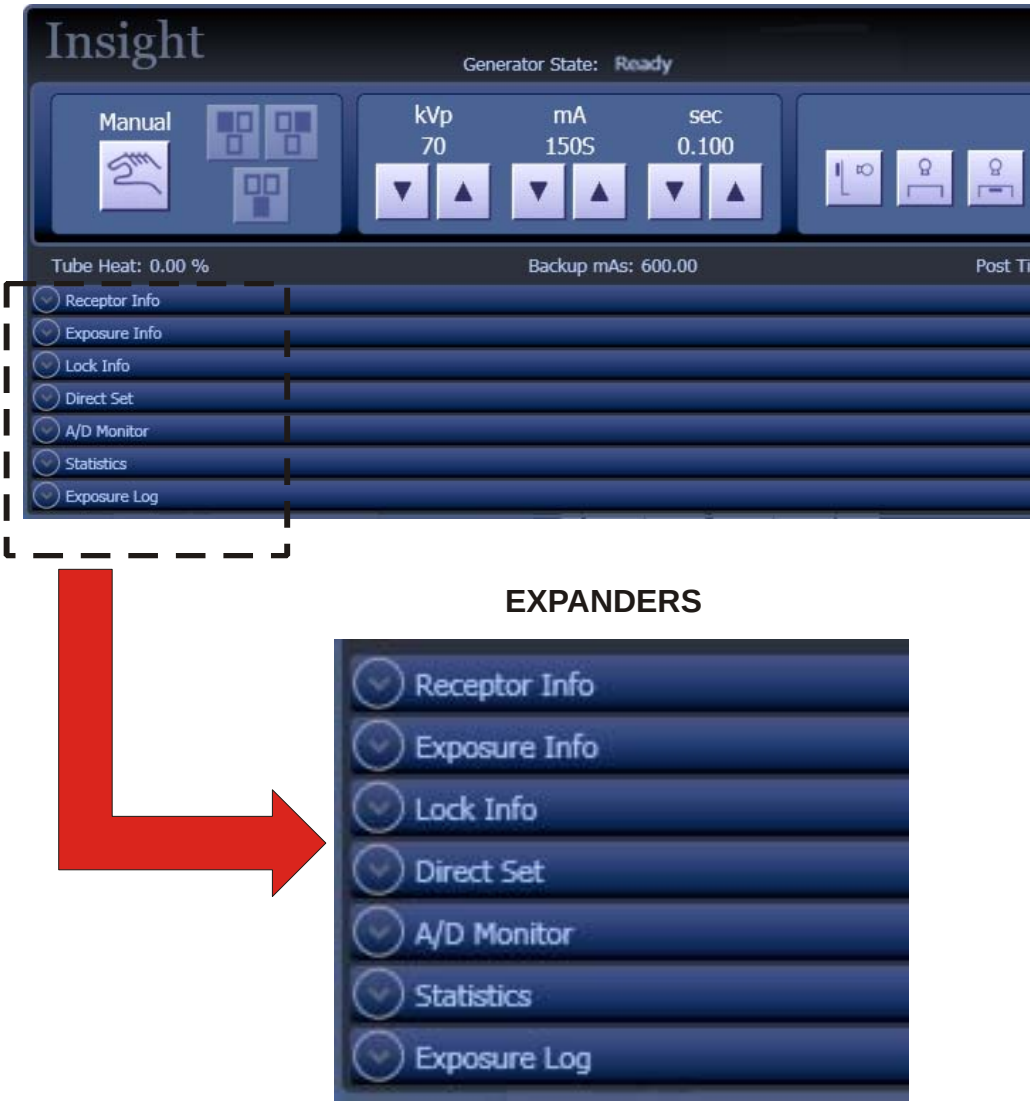


Figure 5-5e. Insight Service Utility Menu

7. The Insight screen features seven expandable service utilities - Receptor Info, Exposure Info, Lock Info, Direct Set, A/D Monitor, Statistics, and Exposure log - for viewing and, where applicable, changing settings of the Generator. Press the **Statistics** expander. The Statistics Screen displays:

Figure 5-5f. Statistics Screen

The Statistics Screen provides access to various types of system information. The following briefly describes the various Statistics Screen selections:

- **Exposure Count**: Indicates total number of exposures taken on generator
- **Average KVP**: provides mean KV value averaged over the total exposures taken on generator
- **Average mA**: provides mean mA value averaged over the total exposures taken on generator
- **Average Time**: provides the sum of exposure times (in seconds) of all exposures taken on generator

Events/Warnings Log

Every time a significant action or event occurs in the generator, its occurrence is recorded in a special location on the Q-VISION computer known as a "log file". This includes normal operations as well as warnings and errors, because all may be useful in viewing normal system operation, as well as viewing abnormal (error) conditions. These errors and events may be useful to help diagnose problems. Hence, an event/warning log viewing utility, referred to as a "Log Viewer" is provided with Q-VISION equipped systems. To access the Log Viewer, proceed as follows:

1. Access the General Service Options menu as described in the previous Statistics Report procedure. In the General Service Options menu, select **Log Viewer**. The Log Viewer screen appears (see Figure 5-5g):

Figure 5-5g. Log Viewer Screen

2. The left column panes of the Log Viewer screen include filters that can be used to focus the Log Viewer contents by selecting particular programs to view (listed in the AppDomain pane), Log Files to view (items listed in the Logger pane), and/or by selecting particular events types (levels) to view (items listed in the Level pane).

3. To view only generator related error messages, select "Quantum.Generator.Master.MasterGenerator" in the Logger pane and select "ERROR" in the Level pane, then touch **Apply Filter** button.

4. The Log Viewer displays all generator error messages that have occurred (see Figure 5-5h).

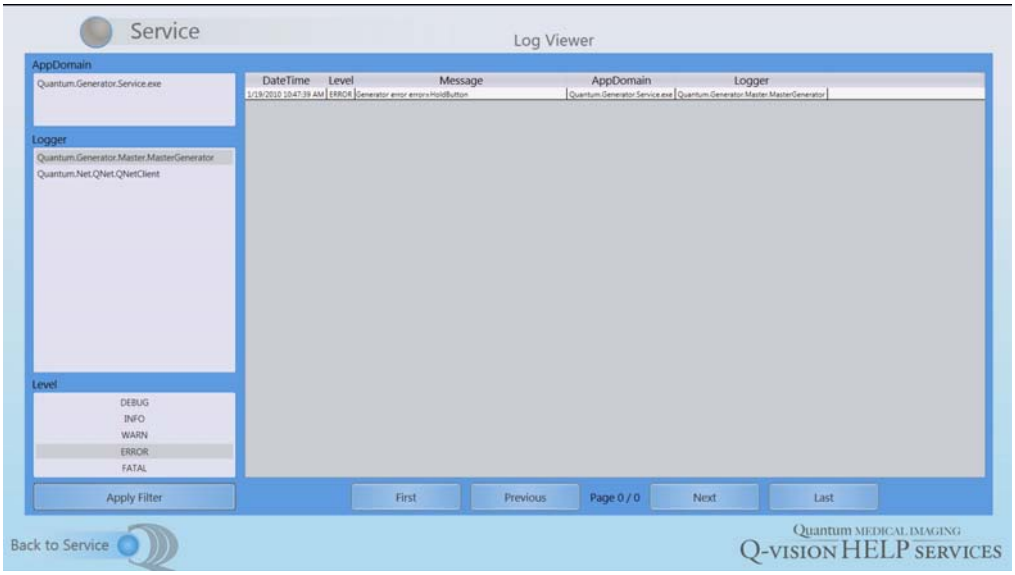


Figure 5-5h. Log Viewer Screen - Filtered for Error Messages (Sample)

5. The Log Viewer lists error messages including the date and time stamp when each occurred. Touching the top of the **DateTime** column toggles the sorting of messages by date and time, from oldest to newest or newest to oldest; touching the top of the **Message** column toggles the sorting of messages alpha-numerically from A to Z or Z to A.
6. If the error messages extend out to multiple pages, touch the **First** button to advance directly to the first page; touch the Last button to advance directly to the last page; use the **Last** button to advance directly to the last page; touch the **Previous** button to advance to the previous page; touch the **Next** button to advance to the next page.
7. Touch the **Back to Service** button to return to the General Service Options Menu.

Accessing Service Reports - Integrated X-ray Generators

The following instructions apply to integrated X-ray generators. On integrated generator systems, as in the Agfa NX Workstation integration or the QG-DIG-CXDI Canon/Quantum Integration, the external imaging system's workstation computer functions as the generator's operator control panel.

The following instructions describe how to access the Generator Statistics Screen on a DiRex integrated system, followed by instructions describing how to access the Generator Statistics Screen on a QG-DIG-CXDI Canon/Quantum Integration System or Agfa NX-DR Series Integration System.

DiRex Integrated System - Statistics Screen

The Statistics Screen is accessed as follows:

1. Set the ON/OFF circuit breaker CB1 on the generator cabinet to ON position.
2. Set the power on/standby switch on the Q-Connect Control Panel (OCP) to the standby (⏻) position, then to the on (⊙) position. The green power LED lamp should illuminate.
3. From the Main OCP Overlay Menu, double click the generator status icon. The "Enter Password" screen appears.
4. In the Enter Password screen, enter the default Service Technician password (58623) using the keypad, then press **Enter**.
5. Upon validation of the password, the Service Options Menu displays. Press the **Generator Service** button.

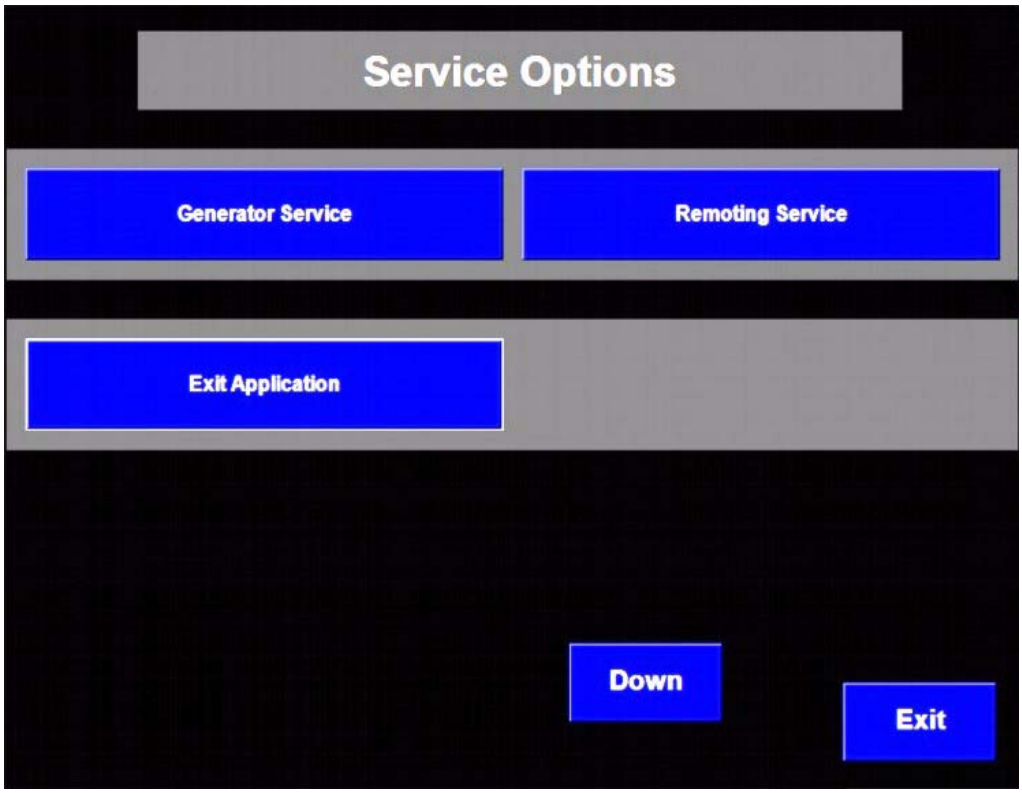


Figure 5-5i. Service Options Menu

6. Press the **Generator Service** button. The Generator Service Menu appears:

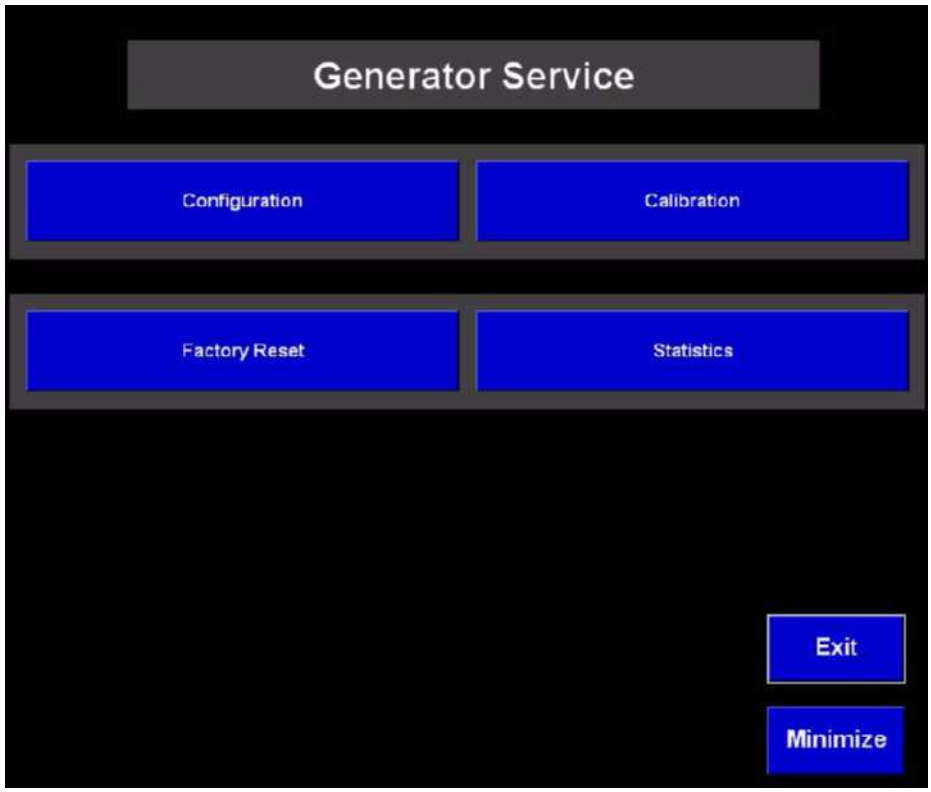


Figure 5-5j. Generator Service Menu

7. Press the **Statistics** button. The Statistics Screen displays:

Figure 5-5k. Statistics Screen

The Statistics Screen provides access to various types of system information. The following briefly describes the various Statistics Screen selections:

- **Exposure Count**: Indicates total number of exposures taken on generator
- **Average KVP**: provides mean KV value averaged over the total exposures taken on generator
- **Average mA**: provides mean mA value averaged over the total exposures taken on generator
- **Average Time**: provides the sum of exposure times (in seconds) of all exposures taken on generator

QG-DIG-CXDI Canon/Quantum and Agfa NX-DR Series Integration System - Statistics Screen

The Statistics Screen is accessed as follows:

1. To gain access to the Generator Service programs, right mouse click on the "Q" icon appearing on the Windows Task Bar (shown on right). The Generator Service Menu (Figure 5-5l) is displayed:

Figure 5-5l. Generator Service Options Menu

2. Select the **Insight** utility option. The "Enter Password" screen appears.

Figure 5-5m. Enter Password Screen

3. In the Enter Password screen, enter the default Service Technician password (58623) using the keypad, then press **Enter**.

4. Upon validation of the password, the "Insight" Service Utility Menu displays:

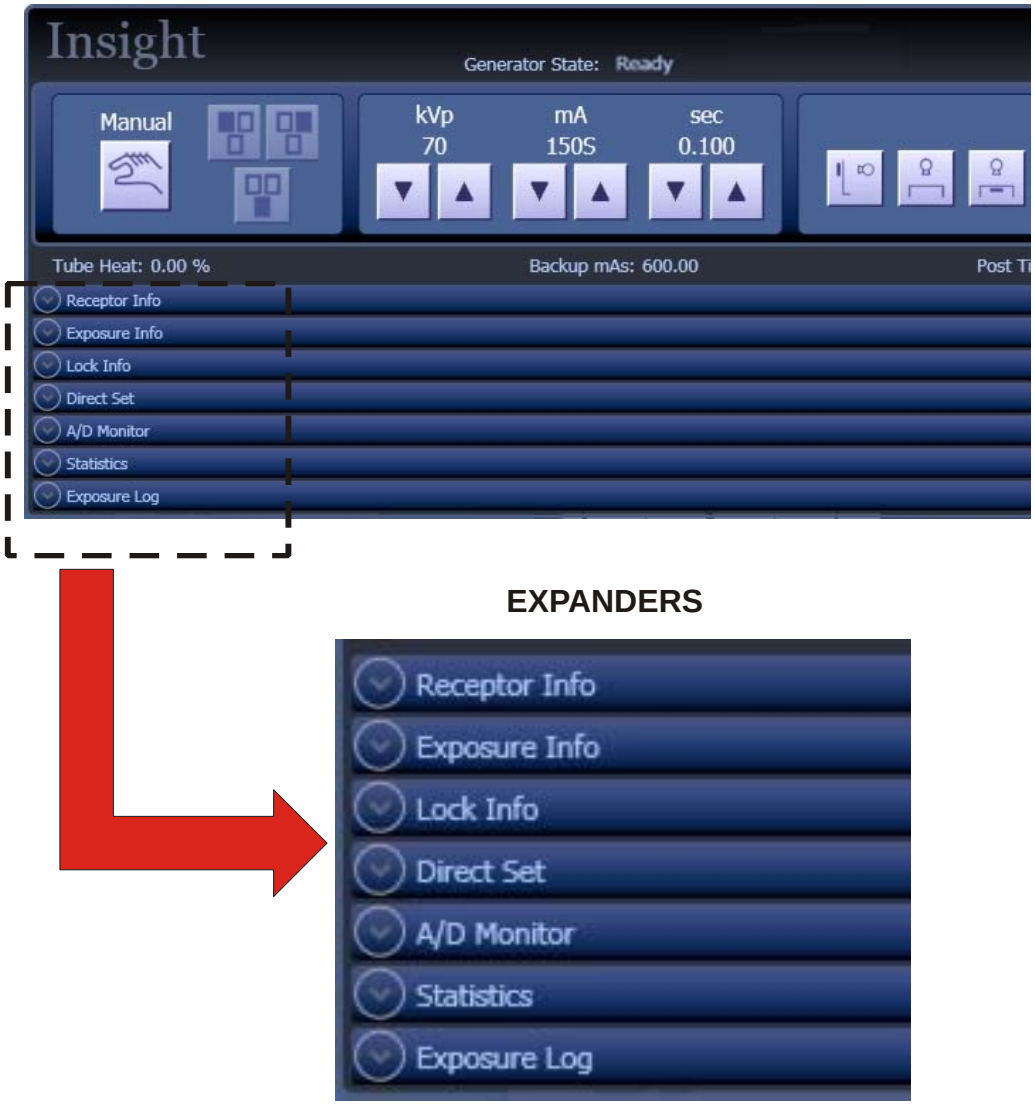


Figure 5-5n. Insight Service Utility Menu

5. The Insight screen features seven expandable service utilities - Receptor Info, Exposure Info, Lock Info, Direct Set, A/D Monitor, Statistics, and Exposure log - for viewing and, where applicable, changing settings of the Generator. Press the **Statistics** expander. The Statistics Screen displays:

Figure 5-5o. Statistics Screen

The Statistics Screen provides access to various types of system information. The following briefly describes the various Statistics Screen selections:

- **Exposure Count**: Indicates total number of exposures taken on generator
- **Average KVP**: provides mean KV value averaged over the total exposures taken on generator
- **Average mA**: provides mean mA value averaged over the total exposures taken on generator
- **Average Time**: provides the sum of exposure times (in seconds) of all exposures taken on generator

Events/Warnings Log

An event/warning log viewing program (*Log4View*) is used to capture and view errors and other events that occur during use of the integrated X-ray generator (Digital Radiographic System integration), as with the DiRex System or a QG-DIG-CXDI Canon/Quantum Integration System. These errors and events may be useful to help diagnose problems. Log4View is a separate program that is accessible outside of the digital operations.

Log4View is installed along with the DiRex, QG-DIG-CXDI Canon/Quantum integration, or NX-DR Quantum/Agfa software installation. It leaves an icon on the desktop that will allow the log to be viewed at any time.

Every time any of the interrelated Quantum Programs that form the integration make a significant action, this is recorded in a file. This includes normal operations as well as warnings and errors because all may be useful in both viewing normal system operation, as well as abnormal (error) conditions.

Refer to Appendix C, LOG4VIEW USER INSTRUCTIONS for details about using the Log4View application.

REMOVAL/REPLACEMENT PROCEDURES

The following procedures provide step-by-step instructions for removal and replacement of the repairable components in the generator.

WARNING! To prevent electrical shock hazards, make sure power is off and capacitors are discharged before proceeding with any removal/ replacement procedures.

Generator Cabinet Cover Removal

1. Set the power on/standby switch on the Operator Control Panel (OCP) to the standby (⏻) position.
2. Set the ON/OFF circuit breaker CB1 on the generator cabinet to OFF position.
3. Loosen nine (9) screws that secure the Generator Cabinet Cover to the Generator Chassis.
4. Wait two minutes before removing the Generator Cabinet Cover to allow the Capacitor Bank to discharge.
5. Carefully slide the Generator Cabinet Cover up and away from the generator to prevent damaging the circuit boards on the generator front door.
6. Connect a DVM across the Capacitor Bank (C9-C11 on Models QG-20-SE, QG-32-SE, QG-40-SE and QG-50-SE; C9-C16 on all other models) to check that the capacitors are fully discharged. If they are fully discharged, it is safe to work on the generator.

Generator Cabinet Cover Replacement

1. Set the ON/OFF circuit breaker CB1 on the generator cabinet to OFF position.
2. Set the power on/standby switch on the Operator Control Panel (OCP) to the standby (⏻) position.
3. Carefully slide the Generator Cover down onto the Generator Chassis cover screws, taking care not to damage the circuit boards on the front door of the Generator.
4. Tighten the nine (9) cover screws to secure the Generator Cabinet Cover to the Generator Chassis.

High Voltage (H.V.) A17 Tank Removal

When removing H.V. Tank A17, keep tank upright at all times. Refer to Figure 2-11 and proceed as follows:

1. Set the power on/standby switch on the Operator Control Panel (OCP) to the standby (⏻) position.
2. Set the ON/OFF circuit breaker CB1 on the generator cabinet to OFF position.
3. Loosen nine (9) screws that secure the Generator Cabinet Cover to the Generator Chassis.
4. Wait two minutes before removing the Generator Cabinet Cover to allow the Capacitor Bank to discharge.
5. Carefully slide the Generator Cabinet Cover up and away from the generator to prevent damaging the circuit boards on the generator front door.
6. Connect a DVM across the positive and negative terminals of the DC Capacitor Bank(s) (C9-C11 on Models QG-20-SE, QG-32-SE, QG-40-SE and QG-50-SE; C9-C16 on all other models) to check that the capacitors are fully discharged. If they are fully discharged, it is safe to work on the generator.
7. When capacitors are fully discharged, remove the Plexiglas shield above the High Voltage Tank.
8. Loosen four (4) screws securing the clear plastic high-voltage acrylic protection panel from the generator chassis and remove panel.
9. Disconnect the anode and cathode high-voltage cables from the High Voltage Tank.
10. Disconnect the Feedback Connector A17P1 from High Voltage Tank connector A17J1.
11. Disconnect H.V. Tank cable PC1 from Power Module A19 lower right IGBT terminal.
12. Disconnect H.V. Tank cable PC2 from the right terminal on Capacitor C7.
13. Disconnect H.V. Tank cable PA1 from the left terminal on Capacitor C4.
14. Disconnect H.V. Tank cable PA2 from Power Module A18 lower left IGBT terminal.
15. Disconnect the yellow/green ground wires from the High Voltage Tank ground stud.

16. Remove the four (4) 1/4-20 x 3/4" socket head cap screws, flat washers and lock washers securing the High Voltage Tank to Generator Chassis.
17. Carefully lift the High Voltage Tank out of the Generator Chassis. If the High Voltage Tank is to be shipped, be sure to tighten the vent screw in the front right corner of the tank.

High Voltage (H.V.) Tank A17 Installation

When installing H.V. Tank A17, keep tank upright at all times. Refer to Figure 2-10 and 2-11 and proceed as follows:

WARNING! After completing the following procedure, double-check the H.V. Tank wiring connections to make sure they are correct. Incorrect wiring can cause damage to the generator.

1. Position H.V. Tanks on H.V. Tank Mounting Brackets so that mounting holes in H.V. Tank align with those in mounting brackets. Secure tank to brackets using four (4) 1/4-20 x 3/4" socket head cap screws, flat washers and lock washers.
2. Loosen the vent screw (located in the front right corner of the tank) two full turns.
3. Connect yellow/green ground wires to H.V. Tank ground stud (GND) using 8/32 kep nut and fasten securely.
4. Connect H.V. Tank cable PC1 to Power Module A19 lower right IGBT terminal.
5. Connect H.V. Tank cable PC2 to right terminal on Capacitor C7.
6. Connect H.V. Tank cable PA1 to the left terminal on Capacitor C4.
7. Connect H.V. Tank cable PA2 to Power Module A18 lower left IGBT terminal.
8. Plug Feedback connector A17P1 (16-pin connector on Cable Assembly AY51-017) into connector A17J1 on the H.V. Tank and tighten connector securely.
9. Connect the anode and cathode high-voltage cables to the High Voltage Tank.
10. Re-install the clear plastic high-voltage protection panel on the Generator Chassis and re-tighten four (4) mounting screws.
11. Carefully slide the Generator Cover down onto the Generator Chassis cover screws, taking care not to damage the circuit boards on the front door of the Generator.
12. Tighten the nine (9) cover screws to secure the Generator Cabinet Cover to the Generator Chassis.

Power Modules A18 and A19 (P/N AY20-047) Removal

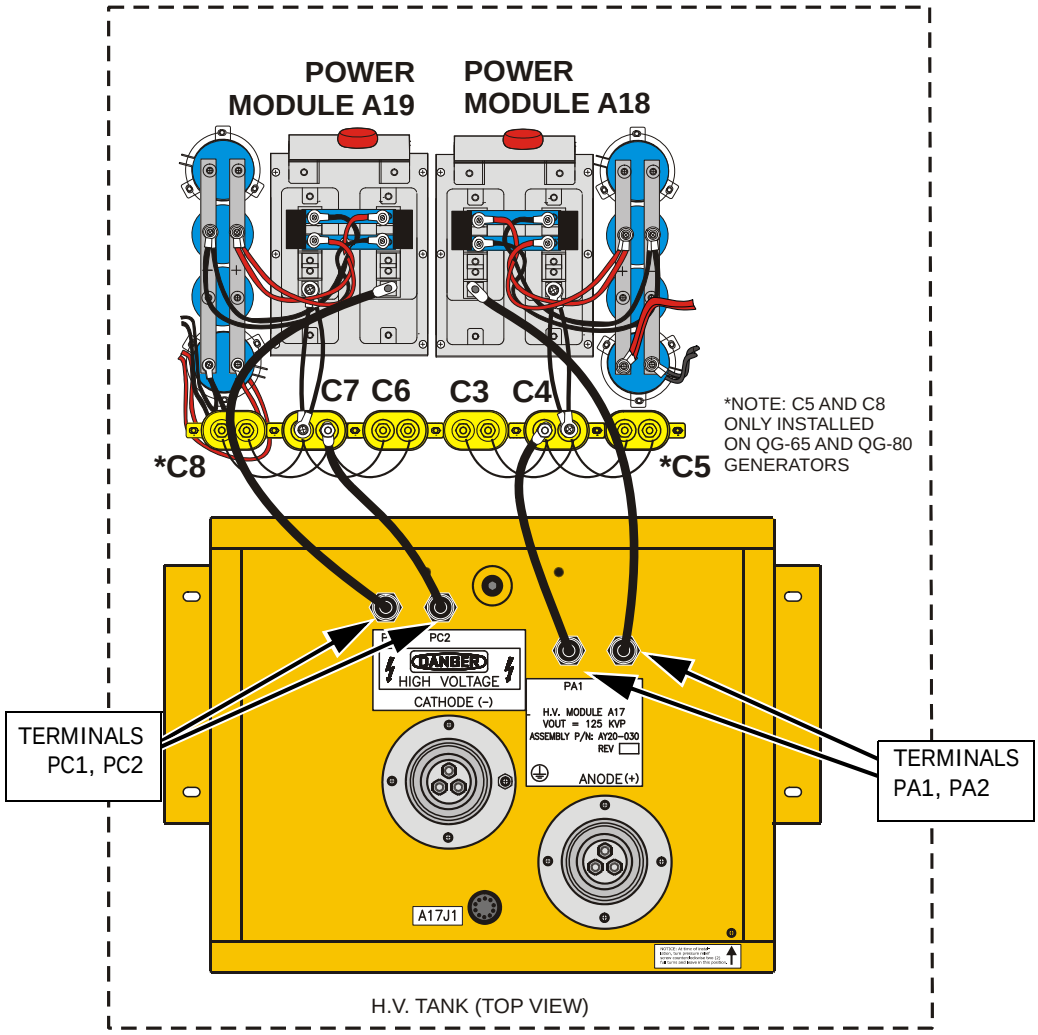


Figure 5-6. Power Module A18 and A19 Cable Connections

1. Set the power on/standby switch on the Operator Control Panel (OCP) to the standby (⏻) position.
2. Set the ON/OFF circuit breaker CB1 on the generator cabinet to OFF position.
3. Loosen nine (9) screws that secure the Generator Cabinet Cover to the Generator Chassis.

4. Wait two minutes before removing the Generator Cover to allow the Capacitor Bank to discharge.
5. Carefully slide the Generator Cabinet Cover up and away from the generator to prevent damaging the circuit boards on the generator front door.
6. Connect a DVM across the DC Capacitor Bank (C9-C16) and verify the capacitors are fully discharged.
7. When capacitors are fully discharged, loosen four (4) screws securing the clear plastic high-voltage acrylic protection panel from the generator chassis and remove panel.
8. Disconnect anode and cathode high-voltage cables from High Voltage Tank.
9. To remove Power Module A18:
    a. Disconnect IGBT Driver Cable (P/N AY51-015) plug A18A3P5 from IGBT Drive Board A18A3 (P/N AY40-010T) connector J5.
    b. Disconnect H.V. Tank cable terminal PA2 from Power Module A18 IGBT lower left IGBT terminal.
    c. Disconnect the two black jumper wires from Power Module A18 lower right IGBT terminal.
    d. Tag and disconnect the red and black cables from Power Module A18 IGBT (+) and (-) bus bars.
    e. Remove the six (6) 8-32 x 1/4" screws that hold Power Module A18 to the rear wall of the Generator Chassis and remove Power Module.
10. To remove Power Module A19:
    a. Disconnect IGBT Driver Cable (P/N AY51-023) plug A19A3P5 from IGBT Drive Board A19A3 (P/N AY40-010T) connector J5.
    b. Disconnect H.V. Tank cable terminal PC1 from Power Module A19 lower right IGBT terminal.
    c. Disconnect the two black jumper wires from Power Module A19 lower left IGBT terminal.
    d. Tag and disconnect the red and black cables from Power Module A18 IGBT (+) and (-) bus bars.
    e. Remove the six (6) 8-32 x 1/4" screws that hold Power Module A19 to the back of the Generator Chassis and remove Power Module.

Power Modules A18 and A19 (P/N AY20-047) Replacement

1. Replace Power Module A18 as follows:
   a. Install Power Module A18 by securing it to the back of the Generator Chassis using six (6) 8-32 x 1/4" screws.
   b. Remove tags and connect the red cable to IGBT (+) terminals and the black cable to IGBT (-) terminal on Power Module A18.
   c. Connect two black jumper wires between Power Module A18 IGBT terminal and the left side lug of resonant capacitor C4.
   d. Connect the IGBT Driver Cable (P/N AY51-015) plug A18A3P5 to IGBT Drive Board A18A3 (P/N AY40-010T) connector J5.
   e. Connect H.V. Tank cable terminal PA2 to Power Module A18 lower left IGBT terminal.
2. Replace Power Module A19 as follows:
   a. Install Power Module A19 by securing it to the back of the Generator Chassis using six (6) 8-32 x 1/4" screws.
   b. Remove tags and connect the red cable to IGBT (+) terminals and the black cable to IGBT (-) terminal on Power Module A19.
   c. Connect two black jumper wires between Power Module A19 IGBT terminal and the right side lug of resonant capacitor C7.
   d. Connect the IGBT Driver Cable (P/N AY51-023) plug A19A3P5 to IGBT Drive Board A19A3 (P/N AY40-010T) connector J5.
   e. Connect H.V. Tank cable terminal PC1 to Power Module A19 lower right IGBT terminal.
3. Re-install the clear plastic high-voltage protection panel on the Generator Chassis and re-tighten four (4) mounting screws.
4. Set the ON/OFF circuit breaker CB1 on the generator cabinet to ON position.
5. Set the power on/standby switch on the Operator Control Panel (OCP) to the on (⊙) position.
6. Connect a DVM between the red and black cables on the IGBT and check that the voltage is between 380 VDC and 420 VDC.
7. Set the power on/standby switch on the Operator Control Panel (OCP) to the standby (⏻) position.
8. Set the ON/OFF circuit breaker CB1 on the generator cabinet to OFF position.

9. Carefully slide the Generator Cover down onto the Generator Chassis cover screws, taking care not to damage the circuit boards on the front door of the Generator.
10. Tighten the nine (9) cover screws to secure the Generator Cabinet Cover to the Generator Chassis.

Logic Board A1 (P/N AY40-006S) Removal

CAUTION! The Logic Board contains electrostatic sensitive devices. Observe proper grounding precautions before handling the Logic Board or any other circuit board.

1. Set the power on/standby switch on the Operator Control Panel (OCP) to the standby (⏻) position.
2. Set the ON/OFF circuit breaker CB1 on the generator cabinet to OFF position.
3. Tag and remove all cables connected to Logic Board A1.
4. If the generator is equipped with Q-Connect option, perform the following additional steps:
   a. Tag and remove ethernet cables connected to OCP Interface Board A1A1 (AY40-073S) connectors J1 and J5.
   b. Remove one (1) screw and two (2) hex nuts securing the OCP Interface Board A1A1 to Logic Board A1 and remove OCP Interface Board.
   c. Note the locations of three (3) OCP Interface Board A1A1 mounting standoffs on Logic Board A1, then remove standoffs from Logic Board A1. Retain standoffs for reassembly.
5. Carefully remove Logic Slave IC U14 and Logic Master IC U9 from Logic Board A1 using a chip puller. Retain IC's for re-installation into replacement board.
6. Remove screws securing Logic Board A1 to the PCB Door and remove the Logic Board.

Logic Board A1 (P/N AY40-006S) Replacement

CAUTION! The Logic Board contains electrostatic sensitive devices. Observe proper grounding precautions before handling the Logic Board or any other circuit board.

1. Place the new Logic Board A1 on standoffs in PCB Door and secure using four (4) screws.
2. If the generator is equipped with Q-Connect option, perform the following additional steps:

a. Install three (3) OCP Interface Board A1A1 mounting standoffs on Logic Board A1 in same locations from which they were removed.

b. Place the OCP Interface Board A1A1 on mounting standoffs and secure using one (1) screw and two (2) hex nuts.

c. Connect ethernet cables to the OCP Interface Board A1A1 connectors J1 and J5.

3. Connect all cables to Logic Board A1. Remove tags.

   Note: When installing IC's, ensure that pin one on the chip is aligned correctly with pin 1 on the IC socket mounted on the board. Do not use software label to orient IC!

4. Insert Logic Master IC U9 (marked "QLBM") into U9 socket on Logic Board A1.

5. Insert the Logic Slave IC U14 (marked "QLBS") into U14 socket on Logic Board A1.

6. On Logic Boards revision G and higher, verify jumpers JP1, JP6, and JP7 are configured as follows:

   a. Jumper JP1 - must always be installed

   b. Jumper JP6 - installed only if system is equipped with high-speed starter (QG-HSS) option. Do not install on standard, single-speed rotor systems (i.e., systems equipped with Rotor Drive Board A10 AY40-013T).

   c. Jumper JP7 - install jumper on pins 2-3

7. Set the ON/OFF circuit breaker CB1 on the generator cabinet to ON position.

8. Set the power on/standby switch on the Operator Control Panel (OCP) to the on (⊙) position.

9. Verify generator passes startup self-tests.

10. Access Service Mode, Service Configuration and Settings screens, and verify generator configuration settings are correct.

11. Access Service Mode, AD Calibration screen. Verify all voltages are within tolerance. If not, calibrate in accordance with "A/D Calibration Procedure" in Chapter 3 (ODYSSEY) or Appendix B (DiRex Integration generators), or Appendix D (all other integrated generators).

12. Spot check kVp and mA calibration and, if needed, re-calibrate system.

KVP Control Board A2 (P/N AY40-003S) Removal

CAUTION! The KVP Control Board contains electrostatic sensitive devices. Observe proper grounding precautions before handling the KVP Control Board or any other circuit board.

1. Set the power on/standby switch on the Operator Control Panel (OCP) to the standby (⏻) position.
2. Set the ON/OFF circuit breaker CB1 on the generator cabinet to OFF position.
3. Tag and remove all cables connected to KVP Control Board A2.
4. Remove four (4) screws securing KVP Control Board A2 to the PCB Door and remove the KVP Control Board.

KVP Control Board A2 (P/N AY40-003S) Replacement

CAUTION! The KVP Control Board contains electrostatic sensitive devices. Observe proper grounding precautions before handling the KVP Control Board or any other circuit board.

1. Verify jumper JP1 on the new KVP Control Board A2 is configured correctly in accordance with the number of power modules used on the system. That is, for single power module systems, install a jumper between pins 2 and 3 of A2JP1 (or solder pins 2 and 3 together). For two power module systems**,** install a jumper between pins 1 and 2 on A2JP1 (or solder pins 1 and 2 together).
2. Place the new KVP Control Board A2 on standoffs in PCB Door and secure using four (4) screws.
3. Connect all cables to KVP Control Board A2. Remove tags.
4. Before closing the Operator Control Panel, verify that the OCP works properly.
5. Set the ON/OFF circuit breaker CB1 on the generator cabinet to ON position.
6. Set the power on/standby switch on the Operator Control Panel (OCP) to the on (⊙) position.
7. Connect an oscilloscope probe to KVP Control Board A2TP21 and another probe to A2TP22. Set the oscilloscope time base to 5 µsec./div. and the vertical amplitude to 5V/div.
8. Remove plugs from connectors A2J7 (anode) and A2J8 (cathode) on KVP Control Board A2. Connect A2TP26 to ground.

9. Press the EXPOSE key. Verify the pulses at each test point are 5.5 µsec. wide and the rising edges of the pulses at A2TP21 are 12 µsec. from the rising edges of the pulses at A2TP22 (see Figure 5-10 for correct waveforms).

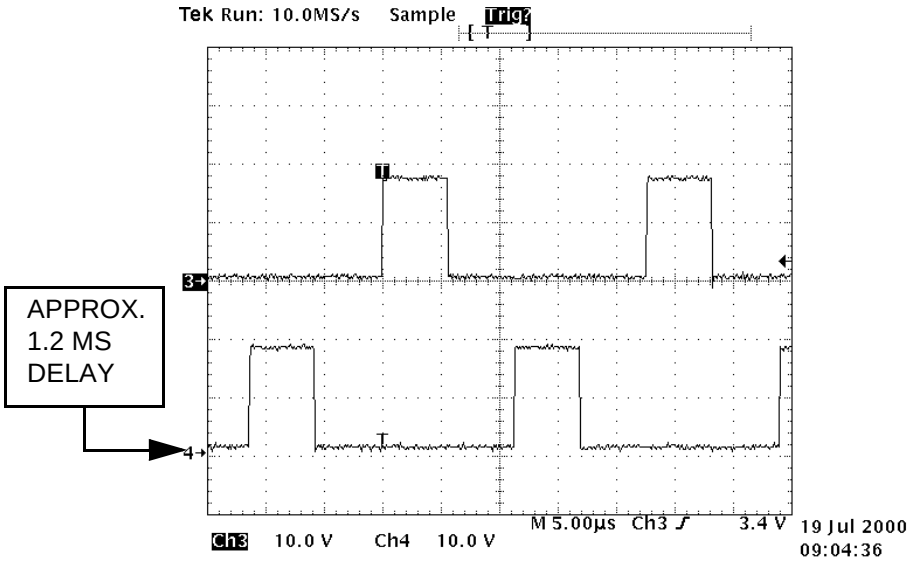


Figure 5-7. KVP Control Board A2TP21 and A2TP22/A2TP23 and A2TP24 Waveforms

10. If the time between the pulses is not 12 µsec., adjust the oscilloscope time base to 0.5 µsec./div. and adjust Anode Output Potentiometer A2R3 to obtain 12.0 ±0.1 µsec.
11. Move oscilloscope probes to A2TP23 and A2TP24.
12. Press the EXPOSE key. Verify the pulses at each test point are 5.5 µsec. wide and the rising edge of the pulses at A2TP23 are 12 µsec. from the rising edges of the pulses at A2TP24.
13. If the time between the pulses is not 12 µsec., adjust the oscilloscope time base to 0.5 µsec./div. and adjust Cathode Output Potentiometer A2R34 to obtain 12 µsec. ±0.1 µsec.
14. Re-insert plugs in connectors A2J7 (anode) and A2J8 (cathode) on KVP Control Board A2.
15. Perform KV, Filament and MA calibration procedures (refer to Chapter 3, Calibration (ODYSSEY) or Appendix B (DiRex Integration generators), or Appendix D (all other integrated generators).

Filament Control Board A5 (P/N AY40-007T) Removal

CAUTION! The Filament Control Board contains electrostatic sensitive devices. Observe proper grounding precautions before handling the KVP Control Board or any other circuit board.

1. Set the power on/standby switch on the Operator Control Panel (OCP) to the standby (⏻) position.
2. Set the ON/OFF circuit breaker CB1 on the generator cabinet to OFF position.
3. Tag and remove all cables connected to Filament Control Board A5.
4. Remove four (4) screws securing Filament Control Board A5 to the PCB Door and remove the Filament Control Board.

Filament Control Board A5 (P/N AY40-007T) Replacement

CAUTION! The Filament Control Board contains electrostatic sensitive devices. Observe proper grounding precautions before handling the Filament Control Board or any other circuit board.

1. Place the new Filament Control Board A5 on standoffs in PCB Door and secure using four (4) screws.
2. Connect all cables to Filament Control Board A5. Remove tags.
3. Set the ON/OFF circuit breaker CB1 on the generator cabinet to ON position.
4. Set the power on/standby switch on the Operator Control Panel (OCP) to the on (⊙) position.
5. Filament Control Board A5 contains one potentiometer (A5R25) that is pre-adjusted at the factory. No further adjustments are necessary for the replacement Filament Control Board, however, it is recommended the following voltages be checked to verify proper installation:
   a. Using a DMM, measure the voltage to ground on either side of fuse A5F1. The voltage should be +48 to +55 VDC. If not, refer to Power Supply Board A6 (AY40-005T) removal and replacement procedure for adjustment instructions.
   b. Connect a DMM between A5TP11 and A5J2-9. On the OCP, select Manual mode, 50 kV, 100L, 50 msec. Press the PREP key. Verify voltage at A5TP11 is +21.6 - 26.4 VDC.
   c. On the OCP, select Manual mode, 50 kV, 150S, 50 msec. Press the PREP key. Verify the voltage at A5TP11 is 1.0 VDC.

d. Perform Filament calibration procedure (refer to Chapter 3, Calibration (ODYSSEY) or Appendix B (DiRex Integration generators), or Appendix D (all other integrated generators)) and re-check mA calibration).

Power Supply Board A6 (P/N AY40-005T) Removal

CAUTION! The Power Supply Board contains electrostatic sensitive devices. Observe proper grounding precautions before handling the Power Supply Board or any other circuit board.

1. Set the power on/standby switch on the Operator Control Panel (OCP) to the standby (⏻) position.
2. Set the ON/OFF circuit breaker CB1 on the generator cabinet to OFF position.
3. Tag and remove all cables connected to Power Supply Board A6.
4. Remove four (4) screws securing Power Supply Board A6 to the PCB Door and remove the Power Supply Board.

Power Supply Board A6 (P/N AY40-005T) Replacement

CAUTION! The Power Supply Board contains electrostatic sensitive devices. Observe proper grounding precautions before handling the Power Supply Board or any other circuit board.

1. Place the new Power Supply Board A6 on standoffs in PCB Door and secure using four (4) screws.
2. Connect all cables to Power Supply Board A6. Remove tags.
3. Set the ON/OFF circuit breaker CB1 on the generator cabinet to ON position.
4. Set the power on/standby switch on the Operator Control Panel (OCP) to the on (⊙) position.
5. Check for the following voltages at specified connector pins/test points:
   a. 24.55 to 27.15 VAC between A6J1-7 and A6J1-8.
   b. +14.25 to +15.75 VDC between A6TP10 and A6TP1.
   c. -14.25 to -15.75 VDC between A6TP5 and A6TP1.
   d. +22.8 to +25.2 VDC between A6TP8 and A6TP1.

Note: The Power Supply Board's +48 VDC output may be adjusted (using A6R17) up to +55 VDC (max.) in cases where long-length high tension cables are used and/or a heavy duty x-ray tube is

installed. This can be determined by measuring the mA output (using a Dynalyzer or mAs meter), of an exposure taken at 40 kVp and the highest mA station available. The mA measured should be the same as the indicated mA (within specified tolerance). If mA output is too low, increase the +48 VDC voltage output as required, but do not exceed +55 VDC. Changing this setting will require verification of proper filament and mA calibration (refer to Chapter 3, CALIBRATION).

e. +47.5 - +48.5 VDC between A6TP3 and A6TP1 (if necessary, adjust A6R17 to obtain this voltage).

6. Access Service Mode, AD Calibration menu. Verify +15 VDC, -15 VDC, +24 VDC, and +24V Brake voltages are within tolerance per Table 3-8. If not, calibrate in accordance with "A/D Calibration Procedure" in Chapter 3, Calibration (ODYSSEY) or Appendix B (DiRex Integration generators), or Appendix D (all other integrated generators.

Line Monitor Board A8 Removal

Line Monitor PCB Usage: AY40-022T1 - Used on Single-Phase Systems; AY40-022T2 - Used on 208-240 VAC Three Phase Systems w/AID High Speed Starter; AY40-022T3 - Used on 380-480 VAC Three-Phase Systems w/AID High Speed Starter; AY40-053S2 - Used on 208-240 VAC Three Phase Systems w/QMI High Speed Starter; AY40-053S3 - Used on 380-480 VAC Three Phase Systems w/QMI High Speed Starter

CAUTION! The Line Monitor Board contains electrostatic sensitive devices. Observe proper grounding precautions before handling the Line Monitor Board or any other circuit board.

1. Set the power on/standby switch on the Operator Control Panel (OCP) to the standby (⏻) position.
2. Set the ON/OFF circuit breaker CB1 on the generator cabinet to OFF position.
3. Tag and remove all cables connected to Line Monitor Board A8.
4. Remove four (4) screws securing Line Monitor Board A8 to the PCB Door and remove the Line Monitor Board.

Line Monitor Board A8 Replacement

Line Monitor PCB Usage: AY40-022T1 - Used on Single-Phase Systems; AY40-022T2 - Used on 208-240 VAC Three Phase Systems w/AID High Speed Starter; AY40-022T3 - Used on 380-480 VAC Three-Phase Systems w/AID High Speed Starter; AY40-053S2 - Used on 208-240 VAC Three Phase Systems w/QMI High Speed Starter; AY40-053S3 - Used on 380-

480 VAC Three Phase Systems w/QMI High Speed Starter

CAUTION! The Line Monitor Board contains electrostatic sensitive devices. Observe proper grounding precautions before handling the Line Monitor Board or any other circuit board.

1. On the replacement Line Monitor Board A8, verify all jumpers are set to same configuration as removed Line Monitor Board.
2. Place new Line Monitor Board A8 on standoffs in PCB Door and secure using four (4) screws.
3. Connect all cables (except A8J1) to Line Monitor Board. Remove tags.
4. Access Service Mode, AD Calibration menu. Verify +400V Cathode and +400V Anode voltages are within tolerance per Table 3-8. If not, calibrate in accordance with "A/D Calibration Procedure" in Chapter 3 (ODYSSEY) or Appendix B (DiRex Integration generators), or Appendix D (all other integrated generators).

Stored Energy Systems Line Monitor/Charger Board A8 (AY40-028T) Removal

CAUTION! The Line Monitor/Charger Board contains electrostatic sensitive devices. Observe proper grounding precautions before handling the Line Monitor/Charger Board or any other circuit board.

1. Set the power on/standby switch on the Operator Control Panel (OCP) to the standby (⏻) position.
2. Set the ON/OFF circuit breaker CB1 on the generator cabinet to OFF position.
3. Using a DVM, confirm the voltage across both DC Power Supply Capacitor Banks has been discharged to below 5VDC. This will take several minutes following shutdown.
4. Each battery tray has mounted on its front center, two cartridge fuses holders housing F1 and F2. Flip up the fuse holder release levers on top of each holder to open the four battery circuits.
5. Tag and remove cables connected to Line Monitor/Charger Board A8.
6. Remove four (4) hex nuts securing the Line Monitor/Charger Board to PCB Door and remove the Line Monitor/Charger Board.

Stored Energy Systems Line Monitor/Charger Board (AY40-028T) A8 Replacement

CAUTION! The Line Monitor Board contains electrostatic sensitive devices. Observe proper grounding precautions before handling the Line Monitor Board or any other circuit board.

1. On the replacement Line Monitor/Charger Board A8, verify all jumpers are set to same configuration as removed Line Monitor/Charger Board.
2. Place new Line Monitor/Charger Board A8 on standoffs in PCB Door and secure using four (4) hex nuts.
3. Reinsert connectors A8P2 through A8P7 into their corresponding jacks A8P2 through A8P7, leaving A8P1 disconnected from A8J1. Remove tags.
4. Pre-adjust potentiometers A8R70 and A8R66 by rotating them fully counterclockwise.
5. Restore the battery circuits by closing the F1 and F2 fuse holders on the two battery trays.
6. Turn the generator ON. Verify that 220VAC (±10%) exists between A8P1-4 and A8J1-7. If these voltages are out of range, test the incoming AC line and confirm the correct taps have been selected at TB1.
7. Once correct, turn OFF the generator and re-attach A8P1 to A8J1.
8. Turn the generator ON. Measure the following A8 test points using a DVM and A8TP13 as ground. Verify these nominal values are within ±5%:
   - A8TP11 = +24VDC
   - A8TP12 = +15VDC
   - A8TP14 = -15VDC
   - A8TP15 = +283VDC
   - A8TP16 = -283VDC
9. Over-voltage Fault Threshold Calibration - Using A8TP13 as a ground:
   a. monitor A8TP21 and adjust A8R19 to measure +2.12VDC (±0.02 VDC).
   b. monitor A8TP20 and adjust A8R60 to measure +2.12VDC (±0.02 VDC).
10. Charger Voltage Limiter Calibration - Using A8TP13 as a ground:

a. Monitor the charger output voltages at A8TP2 (positive supply) and A8TP3 (negative supply) while allowing the chargers to recharge the battery tray(s) until each test point rises to |205| ±1.0 VDC. Note: Charging to these levels may take up to 2 hours. If these levels cannot be achieved, check the integrity of the batteries in the affected side of each tray.

b. Once this level has been achieved at A8TP2, adjust A8R70 to produce Output Limiting, which is indicated when yellow LED A8D7 begins to blink.

11. Similarly, once this level has been achieved at A8TP3, adjust A8R66 to produce Output Limiting, which is indicated when yellow LED A8D25 begins to blink.

NOTE
Rotor Drive Board A10 (AY40-013T) is not used on systems equipped with Dual (High) Speed Starter option (QG-HSS [external] or Q-HSS [internal]).

Rotor Drive Board A10 (P/N AY40-013T) Removal

CAUTION! The Rotor Drive Board contains electrostatic sensitive devices. Observe proper grounding precautions before handling the Rotor Drive Board or any other circuit board.

1. Set the power on/standby switch on the Operator Control Panel (OCP) to the standby (⏻) position.
2. Set the ON/OFF circuit breaker CB1 on the generator cabinet to OFF position.
3. Tag and disconnect Tube Rotor Cable (AY51-014T-XX) from terminal strip A10TB1-1 through A10TB1-7.
4. Tag and remove plugs connected to receptacles A10J1, A10J3, A10J4, and A10J5.
5. Remove four (4) hex nuts securing Rotor Drive Board A10 to the PCB Door and remove the Rotor Drive Board.

Rotor Drive Board A10 (P/N AY40-013T) Replacement

CAUTION! The Rotor Drive Board contains electrostatic sensitive devices. Observe proper grounding precautions before handling the Rotor Drive Board or any other circuit board.

1. Place the new Rotor Drive Board A10 on the PCB Door and secure using four (4) hex nuts.
2. Re-connect plugs to receptacles A10J1, A10J3, A10J4, and A10J5 on Rotor Drive Board.
3. Re-connect Tube Rotor Cable (AY51-014T-XX) wires to terminal strip terminals A10TB1-1 through A10TB1-7.
4. Set the ON/OFF circuit breaker CB1 on the generator cabinet to ON position.

5. Set the power on/standby switch on the Operator Control Panel (OCP) to the on (⊙) position.
6. Perform Rotor Drive Board adjustments as described in the "Rotor Drive Board A10 (AY40-013T) Adjustment" procedure in Chapter 2, Assembly & Installation.

Standard AEC Control Board A11 (P/N AY40-031S) Removal

CAUTION! The AEC Control Drive Board contains electrostatic sensitive devices. Observe proper grounding precautions before handling the AEC Control Drive Board or any other circuit board.

1. Set the power on/standby switch on the Operator Control Panel (OCP) to the standby (⏻) position.
2. Set the ON/OFF circuit breaker CB1 on the generator cabinet to OFF position.
3. Tag and remove plugs connected to A11J1 and A11J4.
4. Disconnect any Wall and/or Table bucky cable(s) connected to A11J2, A11J3, and A11J5.
5. Remove four (4) hex nuts securing AEC Control Board A11 to the PCB Door and remove the AEC Control Board.

Standard AEC Control Board A11 (P/N AY40-031S) Replacement

CAUTION! The AEC Control Board contains electrostatic sensitive devices. Observe proper grounding precautions before handling the AEC Control Drive Board or any other circuit board.

1. Place the new AEC Control Board A10 on the PCB Door and secure using four (4) hex nuts.
2. Re-connect any Wall and/or Table bucky cable(s) to A11J2, A11J3 and A11J5 on AEC Control Board.
3. Re-connect plugs toA11J1 and A11J4 and remove tags.
4. Set the ON/OFF circuit breaker CB1 on the generator cabinet to ON position.
5. Set the power on/standby switch on the Operator Control Panel (OCP) to the on (⊙) position.
6. Perform AEC calibration procedures (refer to Chapter 3, CALIBRATION (ODYSSEY) or Appendix B (DiRex Integration generators), or Appendix D (all other integrated generators).

Universal AEC Control Board A11 (P/N AY40-027S) Removal

CAUTION! The AEC Control Drive Board contains electrostatic sensitive devices. Observe proper grounding precautions before handling the AEC Control Drive Board or any other circuit board.

6. Set the power on/standby switch on the Operator Control Panel (OCP) to the standby (⏻) position.
7. Set the ON/OFF circuit breaker CB1 on the generator cabinet to OFF position.
8. Tag and remove plugs connected to A11J1, A11J5, A11J6, A11J7, A11J9 and A11J11.
9. Disconnect any Wall and/or Table bucky cable(s) connected to A11J8, A11J10, A11J12 and A11J13.
10. If present, tag and remove wires connected to A11TB1 (used for Siemens ion chamber).
11. If present, tag and remove wires connected to A11TB10, A11TB12 and A11TB13 (used with Siemens tomography system).
12. Remove four (4) hex nuts securing AEC Control Board A11 to the PCB Door and remove the AEC Control Board.

Universal AEC Control Board A11 (P/N AY40-027S) Replacement

CAUTION! The AEC Control Board contains electrostatic sensitive devices. Observe proper grounding precautions before handling the AEC Control Drive Board or any other circuit board.

1. Place the new AEC Control Board A10 on the PCB Door and secure using four (4) hex nuts.
2. If applicable, re-connect wires to A11TB10, A11TB12 and A11TB13 (used with Siemens tomography system). Remove tags.
3. If present, re-connect wires to A11TB1 (used for Siemens ion chamber) and remove tags.
4. Re-connect any Wall and/or Table bucky cable(s) to A11J8, A11J10, A11J12 and A11J13 on AEC Control Board.
5. Re-connect plugs to A11J1, A11J5, A11J6, A11J7, A11J9 and A11J11 and remove tags.
6. Set the ON/OFF circuit breaker CB1 on the generator cabinet to ON position.
7. Set the power on/standby switch on the Operator Control Panel (OCP) to the on (⊙) position.
8. Perform AEC calibration procedures (refer to Chapter 3, CALIBRATION).

OCP Microprocessor Board A16 (P/N AY40-004S1) Removal (Not Applicable on Q-VISION or Integrated Generators)

NOTE
The OCP Microprocessor Board A16 (AY40-004S1) is not used on integrated systems or systems equipped with a Q-VISION OCP.

CAUTION! The OCP Microprocessor Board contains electrostatic sensitive devices. Observe proper grounding precautions before handling the OCP Microprocessor Board or any other circuit board.

1. Set the power on/standby switch on the Operator Control Panel (OCP) to the standby (⏻) position.
2. Set the ON/OFF circuit breaker CB1 on the generator cabinet to OFF position.
3. Turn the Operator Control Panel upside down and remove the four (4) screws that secure the Operator Control Panel Bottom Cover to the Operator Control Panel housing, taking care not to scratch the front panel.
4. Tag and remove all cables connected to OCP Microprocessor Board A16A1.
5. Remove eight (8) screws securing OCP Microprocessor Board A16A1 to the front panel and remove OCP Microprocessor Board.
6. To remove the LCD Display (P/N EL31-005 on QUEST systems, EL31-004 on ODYSSEY systems), proceed as follows:
   a. Disconnect the flat cable from A16A1J5 on the OCP Microprocessor Board by pulling on the locking portion of A16A1J5 slightly in order to release the flat cable from the connector.
   b. Remove the four (4) screws that secure the LCD Display to the front panel and remove LCD Display.

OCP Microprocessor Board A16 (P/N AY40-004S1) Replacement (Not Applicable on Q-VISION or Integrated Generators)

CAUTION! The OCP Microprocessor Board contains electrostatic sensitive devices. Observe proper grounding precautions before handling the OCP Microprocessor Board or any other circuit board.

1. To install the LCD Display (P/N EL31-005 on QUEST systems, EL31-004 on ODYSSEY systems), proceed as follows:
   a. Verify board jumpers A16A1JP1, A16A1JP4, A16A1JP6, A16A1JP7, A16A1JP10, A16A1JP11 are installed; jumper A16A1JP12 is installed only if system has QUEST operator control panel.
   b. Secure the LCD Display to front panel using four (4) screws.
   c. Connect the flat cable from the OCP Display to A16A1J5. Check that the blue side of the flat cable faces the bottom

side of the connector.

2. Place the new OCP Microprocessor Board A16A1 on the OCP front panel and secure using eight (8) screws.
3. Connect all cables to OCP Microprocessor Board A16A1.
4. Re-install the Operator Control Panel Bottom Cover on the Operator Control Panel housing using four (4) screws.
5. Turn on system and verify the OCP works properly. Adjust A16A1R17 until the LCD display is a uniform blue color.

Q-HSS Equipped Systems Only: High-Speed Starter Control Board A20A1 (P/N AY40-035S) Removal

CAUTION! The High-Speed Starter Control Board contains electrostatic sensitive devices. Observe proper grounding precautions before handling the High-Speed Starter Control Board or any other circuit board.

1. Set the power on/standby switch on the Operator Control Panel (OCP) to the standby (⏻) position.
2. Set the ON/OFF circuit breaker CB1 on the generator cabinet to OFF position.
3. Tag and remove all cables connected to High-Speed Starter Control Board A20A1.
4. Remove four (4) hex nuts securing High-Speed Starter Control Board A20A1 to the PCB Door and remove High-Speed Starter Control Board.

Q-HSS Equipped Systems Only: High-Speed Starter Control Board A20A1 (P/N AY40-035S) Replacement

CAUTION! The High-Speed Starter Control Board contains electrostatic sensitive devices. Observe proper grounding precautions before handling the High-Speed Starter Control Board or any other circuit board.

1. Place the new High-Speed Starter Control Board A20A1 on the PCB Door standoffs and secure using four (4) hex nuts.
2. Connect all cables to High-Speed Starter Control Board A20A1.
3. Connect a DVM between A20A1U20-7 and GND.
4. Set the ON/OFF circuit breaker CB1 on the generator cabinet to ON position.
5. Set the power on/standby switch on the Operator Control Panel (OCP) to the on (⊙) position.

6. Adjust potentiometer A20R48 to 2.8 - 3.0 VDC for systems equipped with Toshiba E7183X and E7252X tubes, and 4.4 - 4.6 VDC for all other tube types.

Q-HSS Equipped Systems Only: High-Speed Starter Driver Board A20A2 (P/N AY40-036S) Removal

CAUTION! The High-Speed Starter Driver Board contains electrostatic sensitive devices. Observe proper grounding precautions before handling the High-Speed Starter Driver Board or any other circuit board.

1. Set the power on/standby switch on the Operator Control Panel (OCP) to the standby (⏻) position.
2. Set the ON/OFF circuit breaker CB1 on the generator cabinet to OFF position.

WARNING! To prevent electrical shock hazards, make sure power is off and capacitors are discharged before proceeding with any removal/replacement procedures.

3. Verify capacitors A20A2C4, A20A2C5, A20A2C8, and A20A2C9 are fully discharged - wait at least seven minutes, then measure the voltage across A20A1TP19 and A20A1TP20 and verify it is less than 30 VDC before proceeding.
4. Remove three (3) 6-32 hex nuts securing the clear plastic high-voltage shield to the PCB Door standoffs and remove shield.
5. Tag and remove all cables connected to High-Speed Starter Driver Board A20A2.
6. Remove four (4) screws securing High-Speed Starter Driver Board A20A2 to the front panel and carefully remove High-Speed Starter Driver Board.

Q-HSS Equipped Systems Only: High-Speed Starter Driver Board A20A2 (P/N AY40-036S) Replacement

CAUTION! The High-Speed Starter Driver Board contains electrostatic sensitive devices. Observe proper grounding precautions before handling the High-Speed Starter Driver Board or any other circuit board.

CAUTION! To prevent damage, do not handle High-Speed Starter Driver Board by grasping or touching the heat sinks.

1. On replacement High-Speed Starter Driver Board A20A2, verify jumper JP1 is installed.

2. Place the new High-Speed Starter Driver Board A20A2 on the PCB Door standoffs and secure using four (4) hex nuts.
3. Connect all cables to High-Speed Starter Driver Board A20A2.
4. Place clear plastic high-voltage shield on PCB Door standoffs and secure using three (3) 6-32 hex nuts.
5. Set the ON/OFF circuit breaker CB1 on the generator cabinet to OFF position.
6. Set the power on/standby switch on the Operator Control Panel (OCP) to the standby (⏻) position.

Stored Energy System - Battery Tray Removal

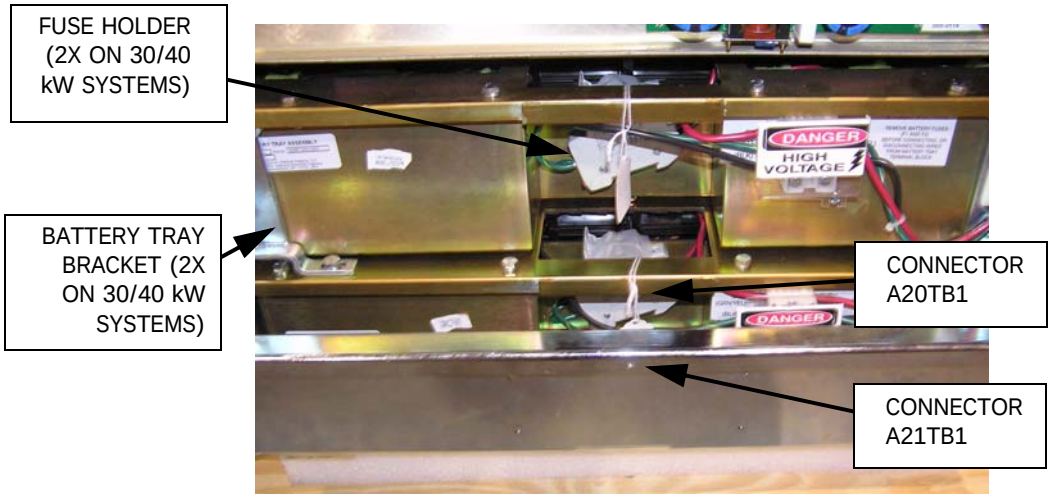


Figure 5-8. Battery Tray Component Location

Caution! These batteries contain Sulfuric Acid (H_2SO_4) and Lead (Pb). Spent Lead-Acid batteries must never be disposed of indiscriminately. QMI requires its dealers to collect and send them to a secondary lead smelter for recycling. In the U.S., any reseller of automotive-type storage batteries is also required to accept spent cells at no cost to you. Avoid damage to the battery casing. Keep away from fire, flame, sparks, and heat. Use care in handling.

Warning! Hazardous voltages (400 VDC) exist inside the Battery Tray Assembly even when power is disconnected from the generator. Use caution when handling; do not put hands/fingers inside Battery Tray Covers.

1. Set the power on/standby switch on the Operator Control Panel (OCP) to the standby (⏻) position.
2. Set the ON/OFF circuit breaker CB1 on the generator cabinet to OFF position.
3. Loosen nine (9) screws that secure the Generator Cabinet Cover to the Generator Chassis.
4. Wait two minutes before removing the Generator Cover to allow the Capacitor Bank to discharge.
5. Carefully slide the Generator Cabinet Cover up and away from the generator to prevent damaging the circuit boards on the generator front door.
6. Connect a DVM across the Capacitor Bank (C9, C10 and C11, C12) to check that the capacitors are fully discharged.
7. When capacitors are fully discharged, open fuse holders for fuses F1 through F4 (see Figure 5-8).
8. Tag and remove red, green/yellow, and black wires from terminal block A20TB1 and A21TB1 (32 and 40 kW systems only).
9. Remove four (4) screws securing left and right side Battery Tray Brackets to sides of Generator Cabinet.
10. Remove screws (two on 20 kW systems, four on 32, 40 and 50 kW systems) securing left and right side Battery Tray Brackets to the Battery Trays. Remove brackets from Generator Cabinet.
11. On 32, 40 and 50 kW systems only: Slide out the top Battery Tray by pulling it slowly towards you. Be careful not to pull out the Battery Tray too far as it may fall to the floor and cause injury. Once the back part of the Battery Tray is accessible, grasp it firmly and carefully lift out the Battery Tray using both hands.
12. Remove the bottom Battery Tray by holding it by the front handle, lifting up and pulling it towards you. Be careful not to catch your fingers between the Battery Tray and the front of the Generator Cabinet. Once the back part of the Battery Tray is accessible, grasp it firmly and carefully lift out the Battery Tray using both hands.

Stored Energy System - Battery Tray Replacement

1. Set the ON/OFF circuit breaker CB1 on the generator cabinet to OFF position.
2. Set the power on/standby switch on the Operator Control Panel (OCP) to the standby (⏻) position.
3. Slide the bottom Battery Tray into the Generator, pushing it all the way towards the back of the Generator Cabinet.
4. On 32, 40 and 50 kW systems only: Slide the top Battery Tray onto the bottom Battery Tray, pushing it all the way towards the back of the Generator Cabinet.
5. Check that the Battery Tray(s) are properly seated inside the Generator. Attach the two brackets to the Battery Tray(s) and secure the brackets to the Generator.
6. Connect red, green/yellow, and black wires to terminal blocks A20TB1 and A21TB1 (32 and 40 kW systems only). Remove tags.
7. Close fuse holders for fuses F1 through F4.
8. Connect a DVM between the red and the green/yellow wires on A20TB1 and check that the voltage is between 185 VDC and 195 VDC. Connect a DVM between the black and the green/yellow wires on A20TB1 and check that the voltage is between 185 VDC and 195 VDC. If this is a 32 or 40 kW system, repeat this check at terminal block A21TB1.
9. Carefully slide the Generator Cabinet Cover down onto the Generator Chassis, taking care not to damage the circuit boards on the front door of the generator.
10. Tighten the nine (9) cover screws to secure the Generator Cabinet Cover to the Generator Chassis.
11. Verify the Line Monitor/Source Charger Board over-voltage fault threshold and charger voltage limiter are calibrated as described in "Stored Energy Systems Line Monitor/Charger Board (AY40-028T) A8 Replacement" procedure contained in this chapter.

REPLACEMENT PARTS AND ORDERING INFORMATION

WARNING! If components that have a direct or indirect influence on safety or radiation protection are replaced, it is essential that only Quantum Medical Imaging specified replacement parts be used.

WARNING! For continued protection against risk of fire, replace only with same type and rating of fuse.

Refer to Figures 6-1 through 6-5 in Chapter 6, DIAGRAMS for a listing of replaceable parts for single phase, stored energy and three-phase X-ray generators and for the locations of the replaceable parts within the system. Use only original replacement parts as supplied or recommended by Quantum Medical Imaging, LLC.

ORDERING INFORMATION

To order replacement parts for the generator, contact the Service/Support Department at;

Quantum Medical Imaging, LLC.
2002-B Orville Drive North
Ronkonkoma, NY 11779-7661 USA
Phone: (631) 567-5800 (x2)
Fax: (631) 567-5074
email: info@qmiteam.com

When ordering replacement parts, supply the following information:

- Model and serial number of equipment
- Part number
- Part description
- Quantity required
- P.O. Number
- Shipping Instructions

When ordering components or parts not listed in the tables of Figures 6-1 through 6-5, a complete description of the part, including its function and location should be provided with the model number and serial number of the unit.

Contact service@qmiteam.com for further information.

Chapter 6

DIAGRAMS

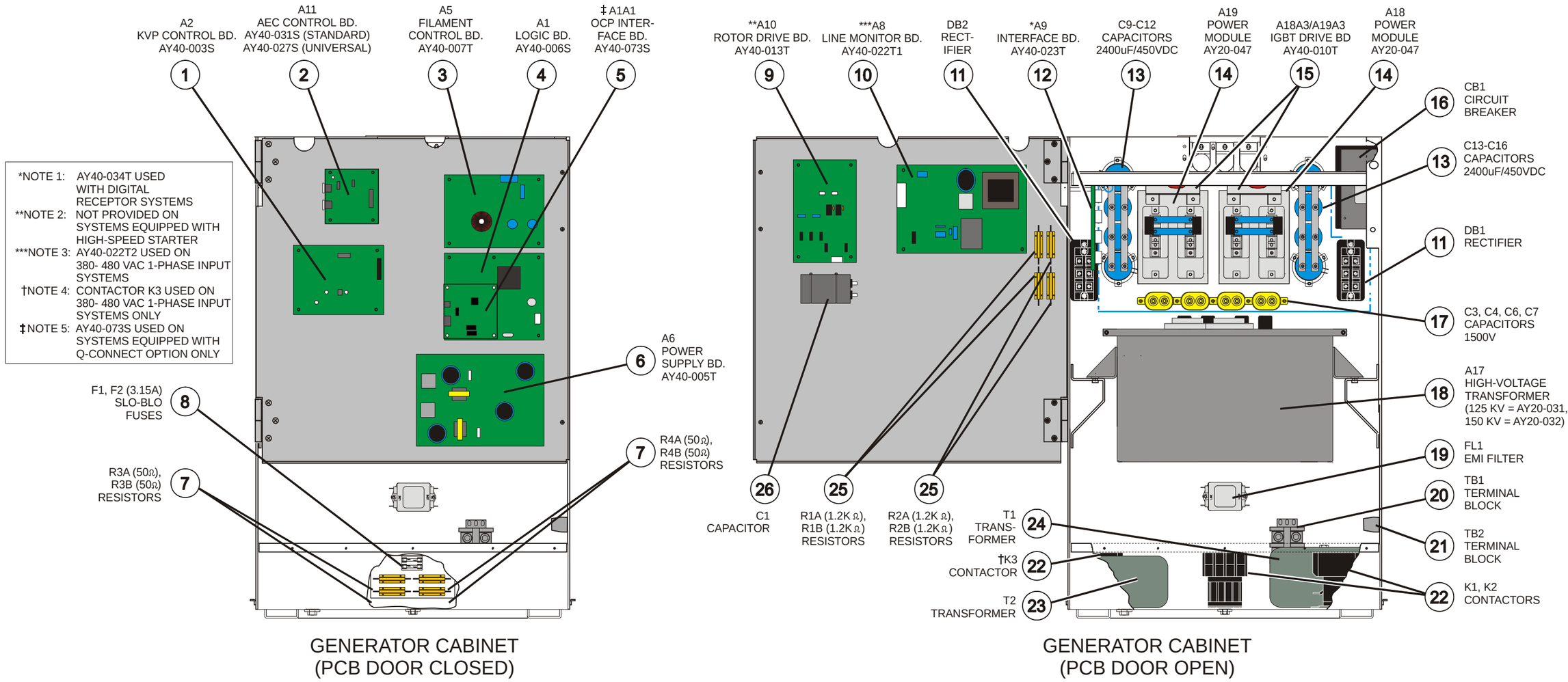
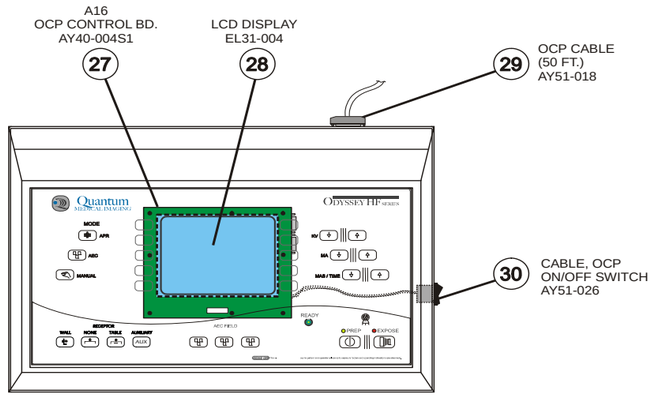

*NOTE 1: AY40-034T USED WITH DIGITAL RECEPTOR SYSTEMS
**NOTE 2: NOT PROVIDED ON SYSTEMS EQUIPPED WITH HIGH-SPEED STARTER
***NOTE 3: AY40-022T2 USED ON 380- 480 VAC 1-PHASE INPUT SYSTEMS
†NOTE 4: CONTACTOR K3 USED ON 380- 480 VAC 1-PHASE INPUT SYSTEMS ONLY
‡NOTE 5: AY40-073S USED ON SYSTEMS EQUIPPED WITH Q-CONNECT OPTION ONLY
1 A2 KVP CONTROL BD. AY40-003S
2 A11 AEC CONTROL BD. AY40-031S (STANDARD) AY40-027S (UNIVERSAL)
3 A5 FILAMENT CONTROL BD. AY40-007T
4 A1 LOGIC BD. AY40-006S
5 ‡A1A1 OCP INTER-FACE BD. AY40-073S
6 A6 POWER SUPPLY BD. AY40-005T
7 R4A (50Ω), R4B (50Ω) RESISTORS
8 F1, F2 (3.15A) SLO-BLO FUSES
7 R3A (50Ω), R3B (50Ω) RESISTORS
GENERATOR CABINET (PCB DOOR CLOSED)
9 **A10 ROTOR DRIVE BD. AY40-013T
10 ***A8 LINE MONITOR BD. AY40-022T1
11 DB2 RECT-IFIER
12 *A9 INTERFACE BD. AY40-023T
13 C9-C12 CAPACITORS 2400uF/450VDC
14 A19 POWER MODULE AY20-047
15 A18A3/A19A3 IGBT DRIVE BD AY40-010T
14 A18 POWER MODULE AY20-047
16 CB1 CIRCUIT BREAKER
13 C13-C16 CAPACITORS 2400uF/450VDC
11 DB1 RECTIFIER
17 C3, C4, C6, C7 CAPACITORS 1500V
18 A17 HIGH-VOLTAGE TRANSFORMER (125 KV = AY20-031, 150 KV = AY20-032)
19 FL1 EMI FILTER
20 TB1 TERMINAL BLOCK
21 TB2 TERMINAL BLOCK
22 K1, K2 CONTACTORS
26 C1 CAPACITOR
25 R1A (1.2K Ω), R1B (1.2K Ω) RESISTORS
25 R2A (1.2K Ω), R2B (1.2K Ω) RESISTORS
24 T1 TRANS-FORMER
22 †K3 CONTACTOR
23 T2 TRANSFORMER
GENERATOR CABINET (PCB DOOR OPEN)

Figure 6-1. Single-Phase (Non-STORED ENERGY) X-ray Generators, 25, 32 and 40 kW Parts Location Diagram (Sheet 1 of 2)

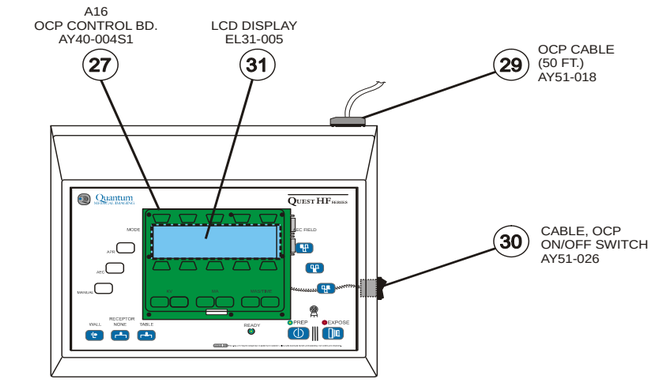
SINGLE-PHASE (NON-SE)
(MODELS QG-25, QG-32, QG-40)
PARTS LIST

ITEM0	DESCRIPTION	PART NUMBER	QTY. USED PER SYSTEM
1	KVP CONTROL BD. (A2)	AY40-003S	1
2	AEC CONTROL BD. (A11), STANDARD TYPE AEC CONTROL BD. (A11), UNIVERSAL TYPE	AY40-031S AY40-027S	1 (OPTION) 1 (OPTION)
3	FILAMENT CONTROL BD. (A5)	AY40-007T	1
4	LOGIC BD. (A1)	AY40-006S	1
5	OCP INTERFACE BD. (A1A1)	AY40-073S	1 (OPTION)
6	POWER SUPPLY BD. (A6)	AY40-005T	1
7	RESISTOR, ALUMIN., 50Ω, 50W (R3A, R3B, R4A, R4B)	EL18-002	4
8	FUSE, AG, SLOW-BLOW, 3.15A (F1, F2)	EL45-025	2
9	ROTOR DRIVE BD. (A10)	AY40-013T	1
10	LINE MONITOR BD. (A8)	AY40-022T1 (USED ON QG-25, QG-32, QG-40) AY40-022T2 (USED ON QG-25-5, QG-32-5, QG-40-5)	1 1
11	RECTIFIER, 150/130 AMP, 800V (DB1, DB2)	EL32-003	2
12	INTERFACE BD. (A9)	AY40-023T AY40-034T (USED ON DIGITAL RECEPTOR SYSTEMS)	1 1
13	CAPACITOR, 2400 uF, 450V (C9-C16)	EL26-004	8
14	POWER MODULE (A18, A19)	AY20-047	2
15	IGBT DRIVE BD. (A18A3, A19A3)	AY40-010T	2
16	CIRCUIT BREAKER, 2-POLE, 50A, 277VAC (CB1) CIRCUIT BREAKER, 2-POLE, 70A, 277VAC (CB1) CIRCUIT BREAKER, 3-POLE, 30A, 600VAC (CB1) CIRCUIT BREAKER, 3-POLE, 50A, 600VAC (CB1)	EL70-002 (USED ON MODEL QG-25, QG-32) EL70-001 (USED ON MODEL QG-40) EL70-005 (USED ON MODEL QG-25-5) EL70-003 (USED ON MODELS QG-32-5, QG-40-5)	1 1 1 1
17	CAPACITOR, 1 uF, 1500V (C3, C4, C6, C7)	EL22-005	4
18	HIGH-VOLTAGE TRANSFORMER (A17)	AY20-031 (125 KV) AY20-032 (150 KV)	1
19	LINE FILTER, 10 AMP, 250VAC (FL1)	EL99-001	1
20	TERMINAL BLOCK, 6-POLE, 85 AMP (TB1)	EL90-009	1
21	TERMINAL BLOCK, 3-POSITION (TB2)	EL90-030	2
22	CONTACTOR, 4-POLE, 24V (K1, K2, K3**)	EL40-006	2 3 (**USED ON MODELS QG-25-5, QG-32-5, AND QG-40-5)
23	TRANSFORMER, AUX. AC SUPPLY (T2)	EL55-002	1
24	TRANSFORMER, PRIMARY AUTO. (T1)	EL55-007 EL55-031	1 1 (USED ON MODELS QG-25-5, QG-32-5, AND QG-40-5)
25	RESISTOR, ALUMIN., 1.2KOHM, 50W (R1A, R1B, R2A, R2B)	EL18-003	4
26*	CAPACITOR, METALIZED, 440V (C1) SEE NOTE BELOW 25 uF 30 uF 45 uF	 EL28-008 EL28-002 EL28-007	 1 1 1
27*	OCP CONTROL BD. (A16)	AY40-004S1	1
28*	LCD DISPLAY (ODYSSEY)	EL31-004	1
29*	OCP SERIAL CABLE (50 FT.)	AY51-018	1
30*	CABLE, OCP ON/OFF SWITCH	AY51-026	1
31*	LCD DISPLAY (QUEST)	EL31-005	1
NOT SHOWN	ROTOR CABLE (FOR VARIAN TUBES) ROTOR CABLE (TOSHIBA TUBES)	AY51-014V-XX AY51-014T-XX	XX=CABLE LENGTH (FT.)

*NOTES:
1. REFER TO CHAPTER 2, ASSEMBLY & INSTALLATION FOR CORRECT PART NOS. AND QUANTITIES OF ROTOR CAPACITOR C1 (ITEM 26).
2. ITEMS 27 THROUGH 31 NOT USED ON GENERATORS EQUIPPED WITH Q-VISION OCP.

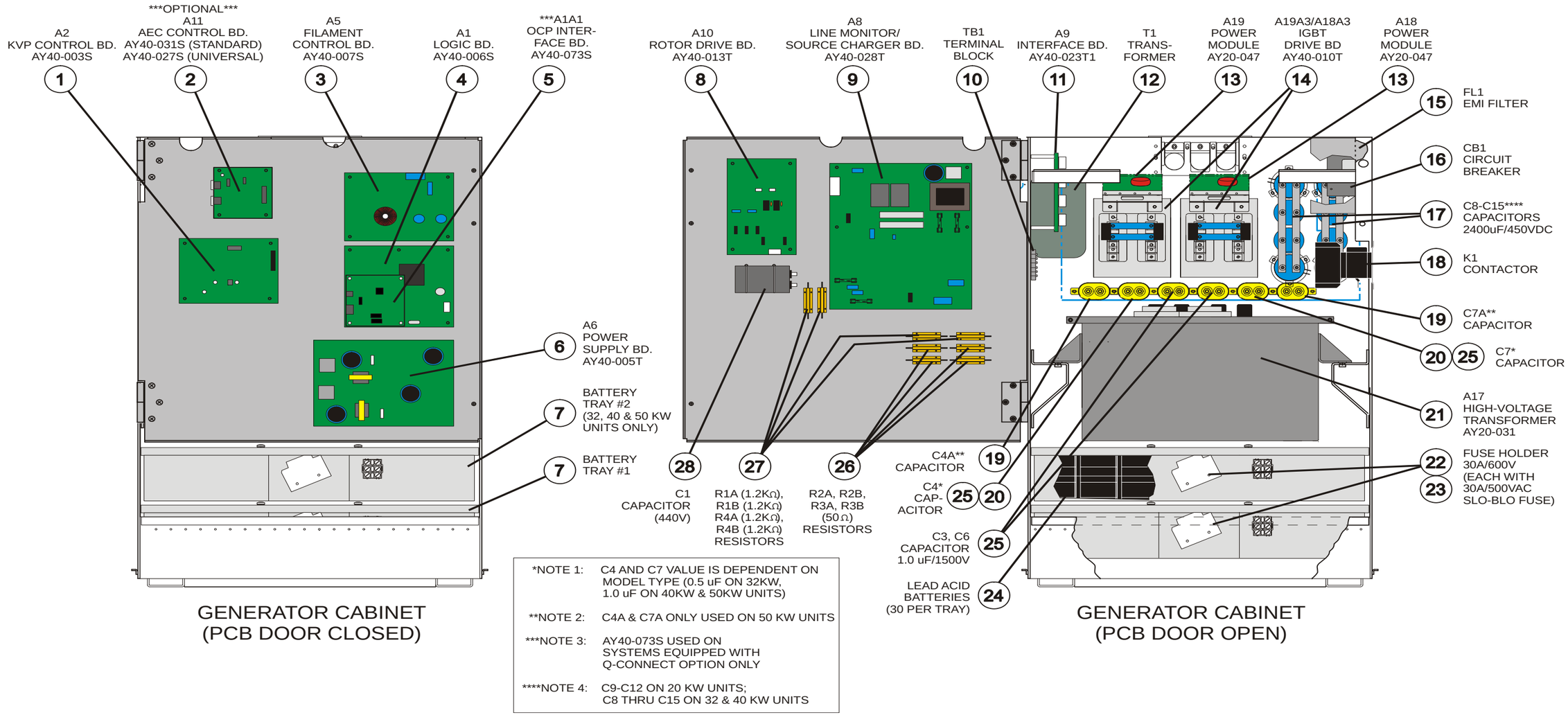


ODYSSEY OPERATOR CONTROL PANEL
(AY10-005)



QUEST OPERATOR CONTROL PANEL
(AY10-004)

Figure 6-1. Single-Phase (Non-STORED ENERGY) X-ray Generators, 25, 32 and 40 kW Parts Location Diagram (Sheet 2 of 2)



*NOTE 1: C4 AND C7 VALUE IS DEPENDENT ON MODEL TYPE (0.5 uF ON 32KW, 1.0 uF ON 40KW & 50KW UNITS)

**NOTE 2: C4A & C7A ONLY USED ON 50 KW UNITS

***NOTE 3: AY40-073S USED ON SYSTEMS EQUIPPED WITH Q-CONNECT OPTION ONLY

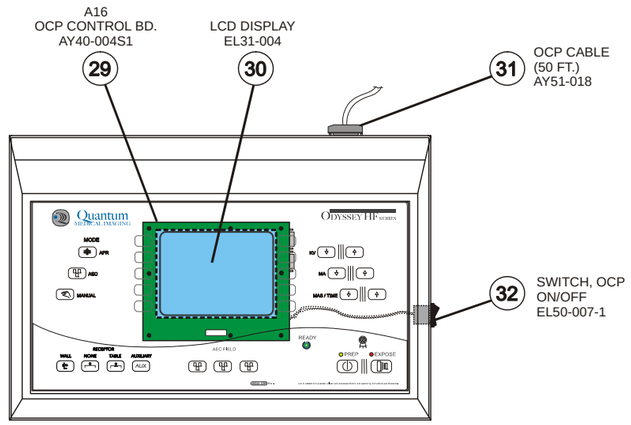
****NOTE 4: C9-C12 ON 20 KW UNITS; C8 THRU C15 ON 32 & 40 KW UNITS

Figure 6-2. Single-Phase (STORED ENERGY) X-ray Generators, 20, 32 40 and 50 kW Parts Location Diagram (Sheet 1 of 2)

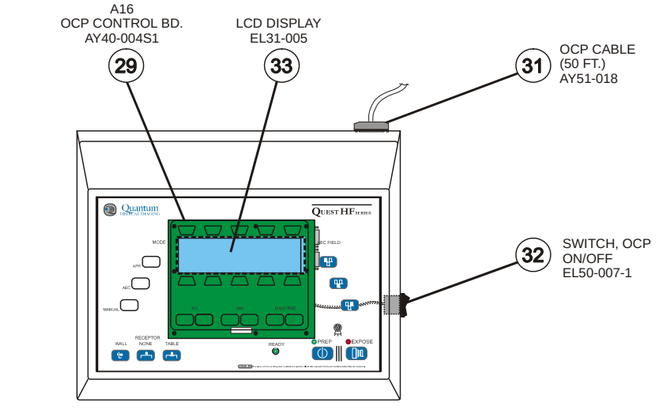
SINGLE-PHASE (STORED ENERGY) PARTS LIST

ITEM	DESCRIPTION	PART NUMBER	QTY. USED PER SYSTEM
1	KVP CONTROL BD. (A2)	AY40-003S	1
2	AEC CONTROL BD. (A11), STANDARD TYPE AEC CONTROL BD. (A11), UNIVERSAL TYPE	AY40-027S AY40-031S	1 (OPTION) 1 (OPTION)
3	FILAMENT CONTROL BD. (A5)	AY40-007T	1
4	OCP INTERFACE BD. (A1A1)	AY40-073S	1 (OPTION)
5	LOGIC BD. (A1)	AY40-006S	1
6	POWER SUPPLY BD. (A6)	AY40-005T	1
7	BATTERY TRAY (#1, #2)	AY20-044	1 (20 KW UNITS) 2 (30 & 40 KW UNITS)
8	ROTOR DRIVE BD. (A10)	AY40-013T	1
9	LINE MONITOR/SOURCE CHARGER BD. (A8)	AY40-028T	1
10	TERMINAL BD. (TB1)	EL90-030	2
11	INTERFACE BD. (A9)	AY40-023T1	1
12	TRANSFORMER, AC SUPPLY (T1)	EL55-011	1
13	POWER MODULE (A18)	AY20-047	1
14	IGBT DRIVE BD. (A18A3)	AY40-010T	1
15	LINE FILTER, 10 AMP, 250VAC (FL1)	EL99-001	1
16	CIRCUIT BREAKER, 2-POLE, 10 AMP, 277VAC (CB1)	EL70-004	1
17	CAPACITOR, 2400 uF, 450V	EL26-004	4 (20 KW UNITS, C9-C12) 8 (32, 40, 50 KW UNITS, C8-C15)
18	CONTACTOR, 4-POLE, 30A/600V (K1)	EL40-006	1
19	CAPACITOR, 0.25 UF, 1500V (C4A, C7A)	EL28-016	2 (50 KW UNITS)
20	CAPACITOR, 0.5 UF, 1500V (C4, C7)	EL28-004	2 (20 & 32 KW UNITS)
21	HIGH-VOLTAGE TRANSFORMER (A17)	AY20-031	1
22	FUSE HOLDER, 30A/600V	EL46-002	1 (20KW UNITS) 2 (32 & 40 KW UNITS)
23	FUSE, SLOW-BLOW, 30A/500VAC (F20-F23)	EL45-010	1 (20KW UNITS) 2 (32 & 40 KW UNITS)
24	LEAD ACID BATTERY, 12V, 2 X 3 MONOBLOC	EL98-001	30 (20KW UNITS) 60 (32, 40 & 50 KW UNITS)
25	CAPACITOR, 1.0 uF, 1500V (C3, C6)	EL22-003	2 (20 & 32 KW UNITS) 4 (40 & 50 KW UNITS)
26	RESISTOR, ALUM., 50 OHM, 50W (R2A, R2B, R3A, R3B)	EL18-002	4
27	RESISTOR, ALUM., 1.2KOHM, 50W (R1A, R1B, R4A, R4B)	EL18-003	4
28	CAPACITOR, METALIZED, 440V (C1) 25 uF – E7239X, E7242X TUBES 30 uF – E7254X, E7255X, VARIAN, DUNLEE TUBES 45 uF – E7813X, E7252X TUBES	 EL28-008 EL28-002 EL28-007	 1 1 1
29	OCP CONTROL BD. (A16)	AY40-004S1	1
30	LCD DISPLAY (ODYSSEY)	EL31-004	1
31	OCP SERIAL CABLE (40 FT.)	AY51-018	1
32	CABLE, OCP ON/OFF SWITCH	AY51-026	1
33	LCD DISPLAY (QUEST)	EL31-005	1
NOT SHOWN	ROTOR CABLE (FOR VARIAN TUBES) ROTOR CABLE (TOSHIBA TUBES)	AY51-014V-XX AY51-014T-XX	XX=CABLE LENGTH (FT.)
SUPPLIED W/TABLE	BUCKY POWER CABLE	EL75-025	SPECIFY LENGTH
SUPPLIED W/TUBESTAND	+24 VOLT POWER CABLE	EL75-004	SPECIFY LENGTH

* NOTES:
1. REFER TO CHAPTER 2, ASSEMBLY & INSTALLATION FOR CORRECT PART NOS. OF C1 ROTOR CAPACITOR (ITEM 28).
2. ITEMS 29 THROUGH 33 NOT USED ON GENERATORS EQUIPPED WITH Q-VISION OCP.

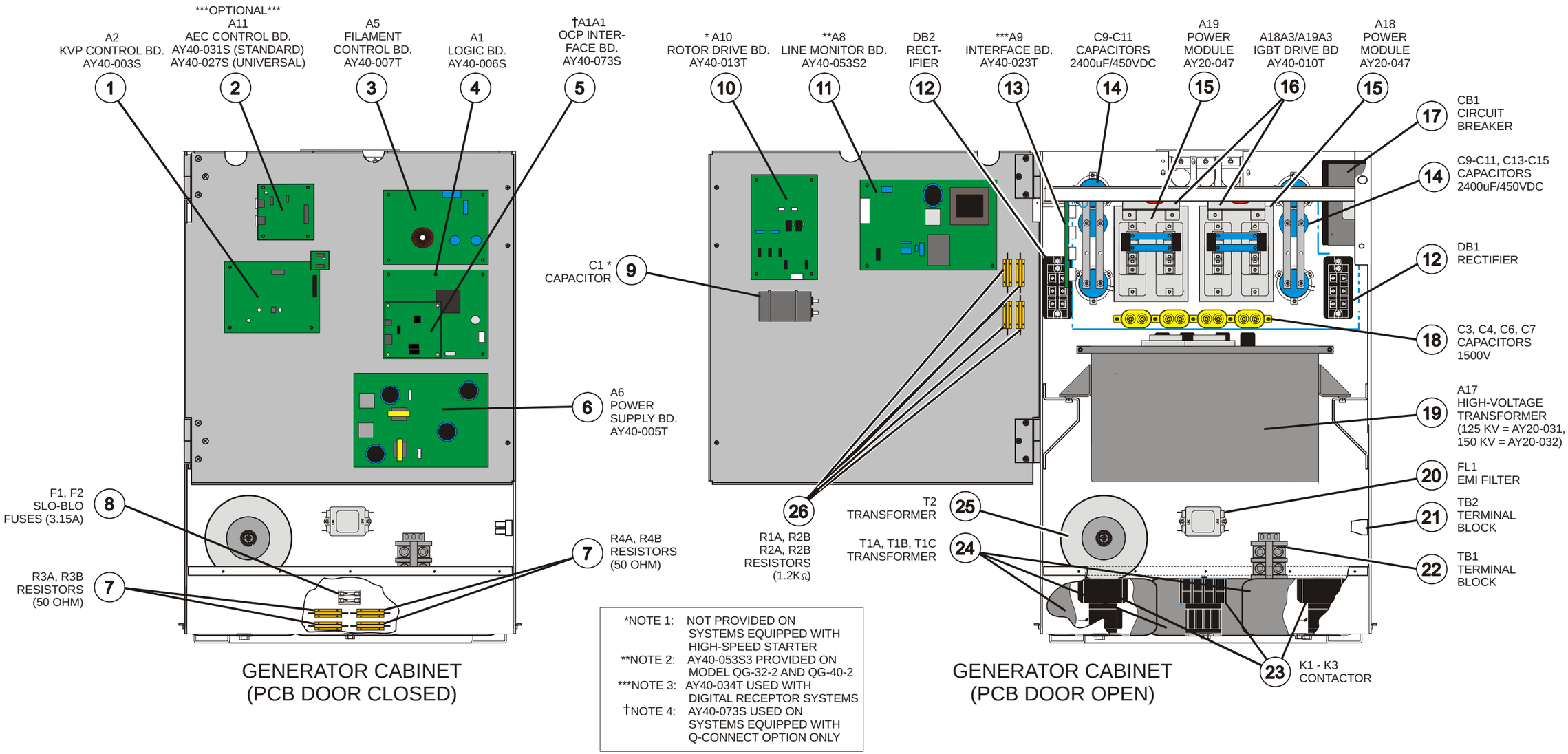


ODYSSEY OPERATOR CONTROL PANEL (AY10-005)



QUEST OPERATOR CONTROL PANEL (AY10-004)

Figure 6-2. Single-Phase (STORED ENERGY) X-ray Generators, 20, 32, 40 and 50 kW Parts Location Diagram (Sheet 2 of 2)



*NOTE 1: NOT PROVIDED ON SYSTEMS EQUIPPED WITH HIGH-SPEED STARTER

**NOTE 2: AY40-053S3 PROVIDED ON MODEL QG-32-2 AND QG-40-2

***NOTE 3: AY40-034T USED WITH DIGITAL RECEPTOR SYSTEMS

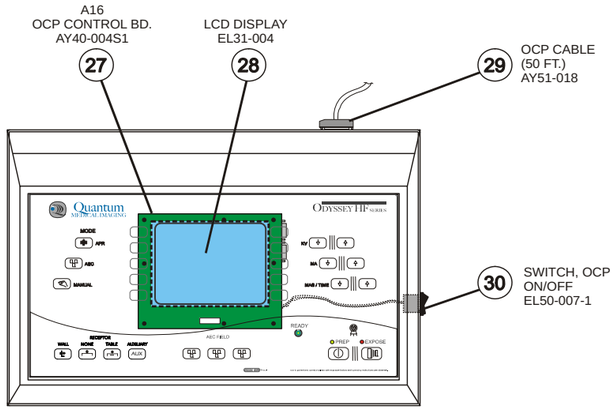
†NOTE 4: AY40-073S USED ON SYSTEMS EQUIPPED WITH Q-CONNECT OPTION ONLY

Figure 6-3. Three-Phase X-ray Generators, 32 and 40 kW Parts Location Diagram (Sheet 1 of 2)

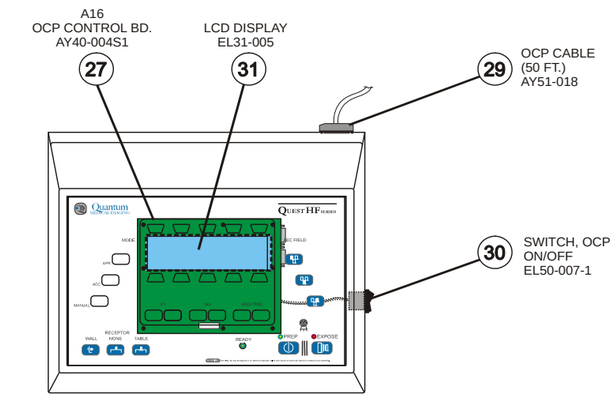
32, 40 kW THREE-PHASE
(MODELS QG-32-2, QG-32-3, QG-40-2, QG-40-3)
PARTS LIST

ITEM	DESCRIPTION	PART NUMBER	QTY. USED PER SYSTEM
1	KVP CONTROL BD. (A2)	AY40-003S	1
2	AEC CONTROL BD. (A11), STANDARD TYPE AEC CONTROL BD. (A11), UNIVERSAL TYPE	AY40-031S AY40-027S	1 (OPTION) 1 (OPTION)
3	FILAMENT CONTROL BD. (A5)	AY40-007T	1
4	LOGIC BD. (A1)	AY40-006S	1
5	OCP INTERFACE BD. (A1A1)	AY40-073S	1 (OPTION)
6	POWER SUPPLY BD. (A6)	AY40-005T	1
7	RESISTOR, ALUMIN., 50Ω, 50W (R3A, R3B, R4A, R4B)	EL18-002	4
8	FUSE, AG, SLOW-BLOW, 3.15A (F1, F2)	EL45-025	2
9*	CAPACITOR, METALIZED 440V (C1) 25 uF – E7239X, E7242X TUBES 30 uF – E7254X, E7255X, VARIAN, DUNLEE TUBES 45 uF – E7813X, E7252X TUBES	 EL28-008 EL28-002 EL28-007	 (NOT REQUIRED IF 1 SYSTEM IS EQUIPPED 1 WITH HIGH-SPEED 1 STARTER OPTION)
10*	ROTOR DRIVE BD. (A10)	AY40-013T	1
11	LINE MONITOR BD. (A8)	AY40-053S3 AY40-053S2	1 (MODELS QG-32-2, QG-40-2) 1 (MODELS QG-32-3, QG-40-3)
12	RECTIFIER, 150/130 AMP, 800V (DB1, DB2)	EL32-003	2
13	INTERFACE BD. (A9)	AY40-023T AY40-034T	1 1 (USED ON DIGITAL RECEPTOR SYSTEMS)
14	CAPACITOR, 2400 uF, 450V (C9-C11, C13-C15)	EL26-004	6
15	POWER MODULE (A18), (A19)	AY20-047	2
16	IGBT DRIVE BD. (A18A3, A19A3)	AY40-010T	2
17	CIRCUIT BREAKER, 3-POLE, 30 AMP, 600VAC (CB1)	EL70-005	1
18	CAPACITOR, 1 uF, 1500V (C3, C4, C6, C7)	EL22-005	4
19	HIGH-VOLTAGE TRANSFORMER (A17)	AY20-031 (125 KV) AY20-032 (150 KV OPTION)	1
20	LINE FILTER, 10 AMP, 250VAC (FL1)	EL99-001	1
21	TERMINAL BLOCK, 3-POSITION (TB2)	EL90-030	4
22	TERMINAL BLOCK, 4-POSITION (TB1)	EL90-022	1
23	CONTACTOR, 4-POLE, 24V (K1 - K3)	EL40-006	3
24	TRANSFORMER, AUTO 3-PHASE (T1A-T1C) 40 KW	 EL55-027 EL55-022	 3 (MODELS QG-32-2, QG-40-2) 3 (MODELS QG-32-3, QG-40-3)
25	TRANSFORMER, AUX. AC SUPPLY (T2)	EL55-002	1
26	RESISTOR, ALUM., 1.2KOHM, 50W (R1A, R1B, R2A, R2B)	EL18-003	4
27*	OCP CONTROL BD. (A16)	AY40-004S1	1
28*	LCD DISPLAY (ODYSSEY)	EL31-004	1
29*	OCP SERIAL CABLE (50 FT.)	AY51-018	1
30*	SWITCH, OCP ON/OFF	EL50-007-1	1
31*	LCD DISPLAY (QUEST)	EL31-005	1
NOT SHOWN	ROTOR CABLE (FOR VARIAN TUBES) ROTOR CABLE (TOSHIBA TUBES)	AY51-014V-XX AY51-014T-XX	XX=CABLE LENGTH (FT.)
SUPPLIED W/TABLE	BUCKY POWER CABLE	EL75-025	SPECIFY LENGTH
SUPPLIED W/TUBE STAND	+24 VOLT POWER CABLE	EL75-004	SPECIFY LENGTH

*NOTES:
1. REFER TO CHAPTER 2, ASSEMBLY & INSTALLATION FOR CORRECT PART NOS. OF C1 ROTOR CAPACITOR (ITEM 9).
2. ITEM 10 NOT REQUIRED IF SYSTEM IS EQUIPPED WITH HIGH-SPEED STARTER OPTION.
3. ITEMS 27 THROUGH 31 NOT USED ON GENERATORS EQUIPPED WITH Q-VISION OCP.

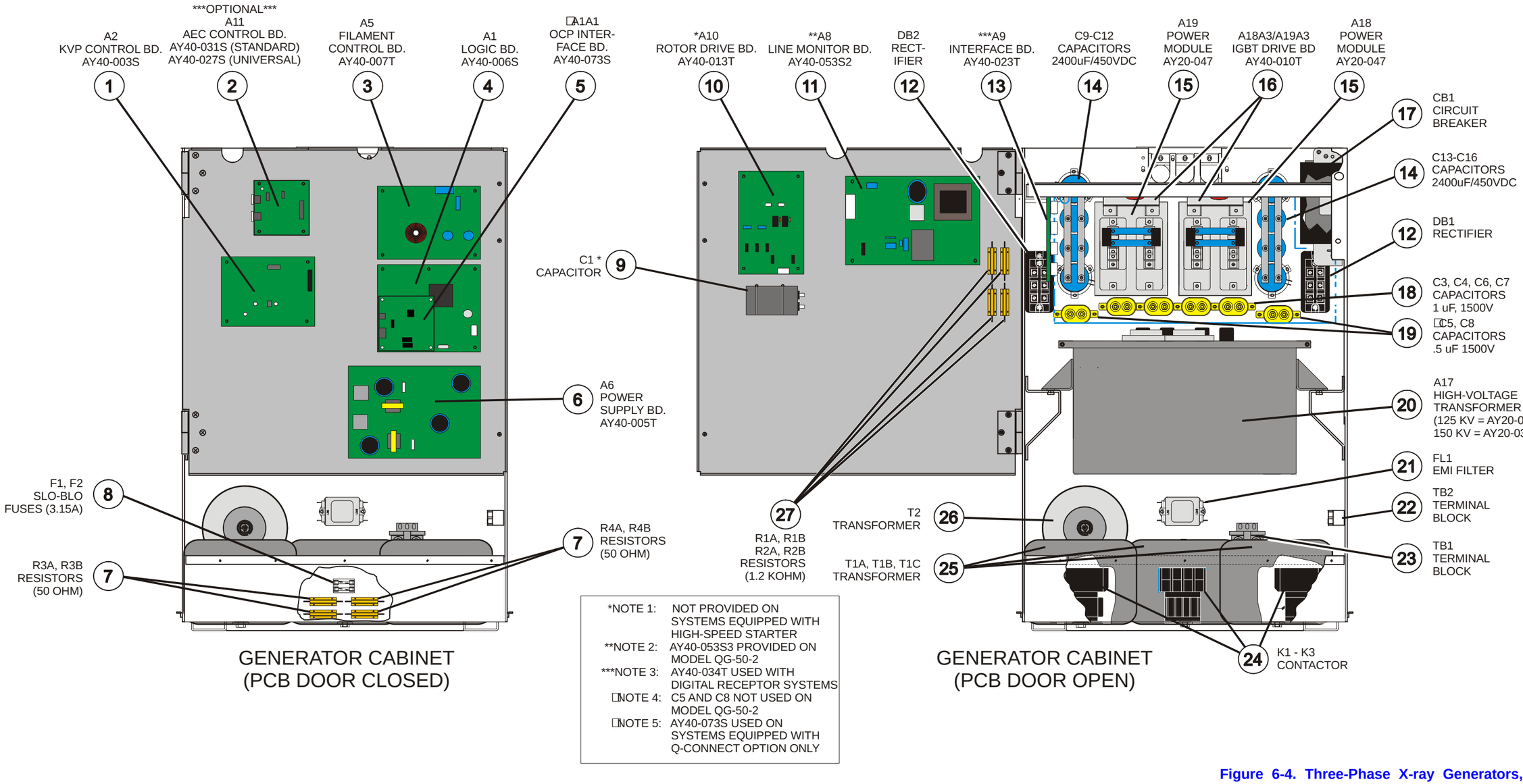


ODYSSEY OPERATOR CONTROL PANEL (AY10-005)



QUEST OPERATOR CONTROL PANEL (AY10-004)

Figure 6-3. Three-Phase X-ray Generators, 32 and 40 kW Parts Location Diagram (Sheet 2 of 2)



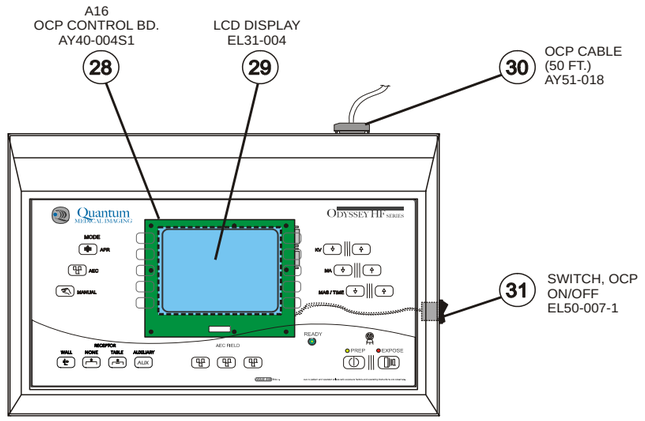
*NOTE 1: NOT PROVIDED ON SYSTEMS EQUIPPED WITH HIGH-SPEED STARTER
**NOTE 2: AY40-053S3 PROVIDED ON MODEL QG-50-2
***NOTE 3: AY40-034T USED WITH DIGITAL RECEPTOR SYSTEMS
□NOTE 4: C5 AND C8 NOT USED ON MODEL QG-50-2
□NOTE 5: AY40-073S USED ON SYSTEMS EQUIPPED WITH Q-CONNECT OPTION ONLY

Figure 6-4. Three-Phase X-ray Generators, 50, 65 and 80 kW Parts Location Diagram (Sheet 1 of 2)

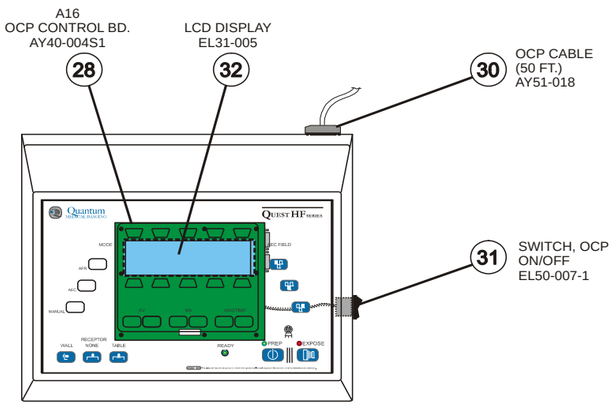
QG-50, QG-50-2, QG-65 AND QG-80 THREE-PHASE PARTS LIST

ITEM	DESCRIPTION	PART NUMBER	QTY. USED PER SYSTEM
1	KVP CONTROL BD. (A2)	AY40-003S	1
2	AEC CONTROL BD. (A11), STANDARD TYPE AEC CONTROL BD. (A11), UNIVERSAL TYPE	AY40-031S AY40-027S	1 (OPTION) 1 (OPTION)
3	FILAMENT CONTROL BD. (A5)	AY40-007T	1
4	LOGIC BD. (A1)	AY40-006S	1
5	OCP INTERFACE BD. (A1A1)	AY40-073S	1 (OPTION)
6	POWER SUPPLY BD. (A6)	AY40-005T	1
7	RESISTOR, ALUMIN., 50Ω, 50W (R3A, R3B, R4A, R4B)	EL18-002	4
8	FUSE, AG, SLOW-BLOW, 3.15A (F1, F2)	EL45-025	2
9*	CAPACITOR, METALIZED 440V (C1) 25 uF – E7239X, E7242X TUBES 30 uF – E7254X, E7255X, VARIAN, DUNLEE TUBES 45 uF – E7813X, E7252X TUBES	 EL28-008 EL28-002 EL28-007	 1 1 1
10*	ROTOR DRIVE BD. (A10)	AY40-013T	1
11	LINE MONITOR BD. (A8)	AY40-053S2 AY40-053S3	1 (MODELS QG-50, QG-65, QG-80) 1 (MODEL QG-50-2)
12	RECTIFIER, 150/130 AMP, 800V (DB1, DB2)	EL32-003	2
13	INTERFACE BD. (A9)	AY40-023T AY40-034T	1 1 (USED ON DIGITAL RECEPTOR SYSTEMS)
14	CAPACITOR, 2400 uF, 450V (C9-C16)	EL26-004	8
15	POWER MODULE (A18, A19)	AY20-047	2
16	IGBT DRIVE BD. (A18A3, A19A3)	AY40-010T	2
17	CIRCUIT BREAKER, 3-POLE, 50 AMP, 600VAC (CB1)	EL70-003	1
18	CAPACITOR, 1 uF, 1500V (C3, C4, C6, C7)	EL22-005	4
19	CAPACITOR, 0.5 uF, 1500V (C5, C8)	EL28-004	2 (NOT USED ON MODEL Q6-50-2)
20	HIGH-VOLTAGE TRANSFORMER (A17)	AY20-031 (125 KV) AY20-032 (150 KV OPTION)	1
21	LINE FILTER, 10 AMP, 250VAC (FL1)	EL99-001	1
22	TERMINAL BLOCK, 3-POSITION (TB2)	EL90-030	4
23	TERMINAL BLOCK, 3-POSITION (TB1)	EL90-009	1
24	CONTACTOR, 4-POLE, 24V (K1 - K3)	EL40-006	3
25	TRANSFORMER, AUTO 3-PHASE (T1A-T1C)	EL55-009 EL55-027	3 (MODELS QG-50, QG-65, QG-80) 3 (MODEL QG-50-2)
26	TRANSFORMER, AUX. AC SUPPLY (T2)	EL55-002	1
27	RESISTOR, ALUMIN., 1.2KOHM, 50W (R1A, R1B, R2A, R2B)	EL18-003	4
28*	OCP CONTROL BD. (A16)	AY40-004S1	1
29*	LCD DISPLAY (ODYSSEY)	EL31-004	1
30*	OCP SERIAL CABLE (50 FT.)	AY51-018	1
31*	SWITCH, OCP ON/OFF	EL50-007-1	1
32*	LCD DISPLAY (QUEST)	EL31-005	1
NOT SHOWN	ROTOR CABLE (FOR VARIAN TUBES) ROTOR CABLE (TOSHIBA TUBES)	AY51-014V-XX AY51-014T-XX	XX=CABLE LENGTH (FT.)
SUPPLIED W/TABLE	BUCKY POWER CABLE	EL75-025	SPECIFY LENGTH
SUPPLIED W/TUBE STAND	+24 VOLT POWER CABLE	EL75-004	SPECIFY LENGTH

* NOTES:
1. REFER TO CHAPTER 2, ASSEMBLY & INSTALLATION FOR CORRECT PART NOS. OF C1 ROTOR CAPACITOR (ITEM 9).
2. ITEM 10 NOT REQUIRED IF SYSTEM IS EQUIPPED WITH HIGH-SPEED STARTER OPTION.
3. ITEMS 28 THROUGH 32 NOT USED ON GENERATORS EQUIPPED WITH Q-VISION OCP.

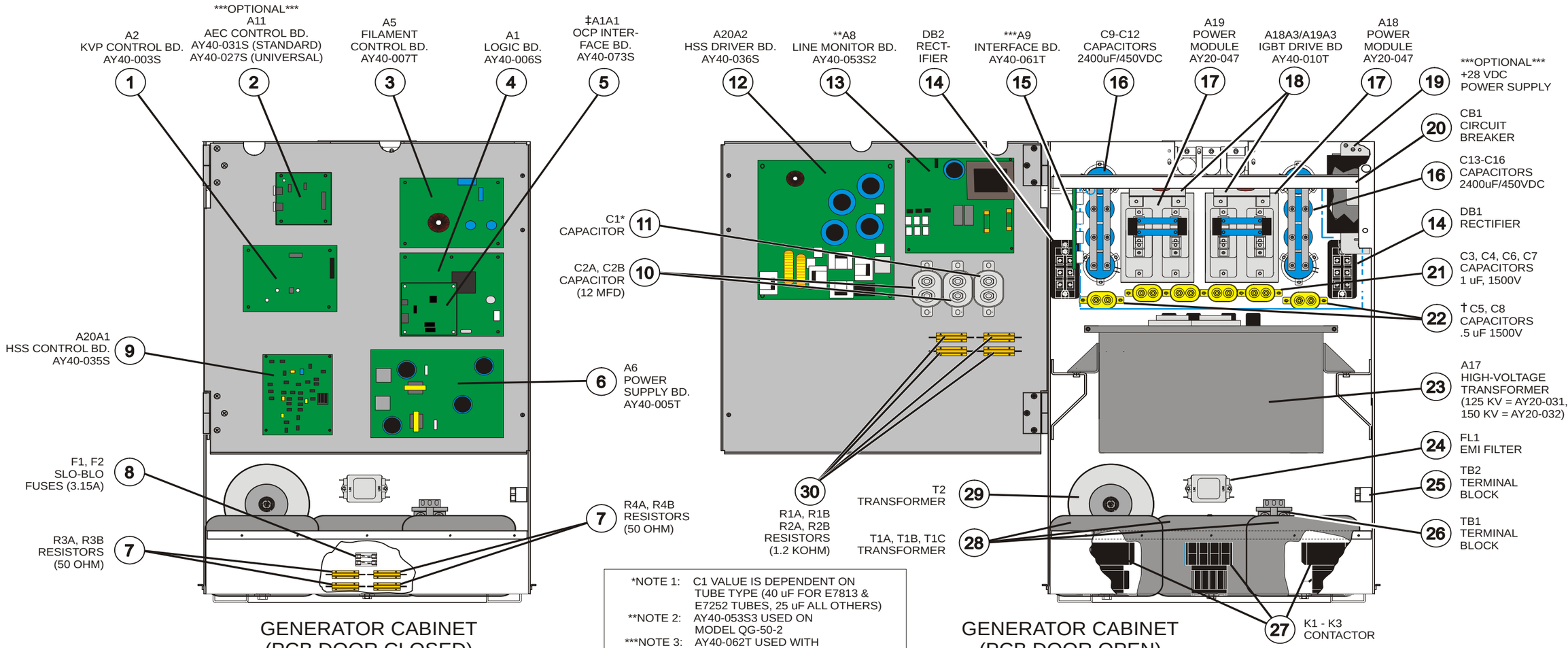


ODYSSEY OPERATOR CONTROL PANEL (AY10-005)



QUEST OPERATOR CONTROL PANEL (AY10-004)

Figure 6-4. Three-Phase X-ray Generators, 50, 65 and 80 kW Parts Location Diagram (Sheet 2 of 2)



*NOTE 1: C1 VALUE IS DEPENDENT ON TUBE TYPE (40 uF FOR E7813 & E7252 TUBES, 25 uF ALL OTHERS)

**NOTE 2: AY40-053S3 USED ON MODEL QG-50-2

***NOTE 3: AY40-062T USED WITH DIGITAL RECEPTOR SYSTEMS

†NOTE 4: C5 AND C8 NOT USED ON MODEL QG-50-2

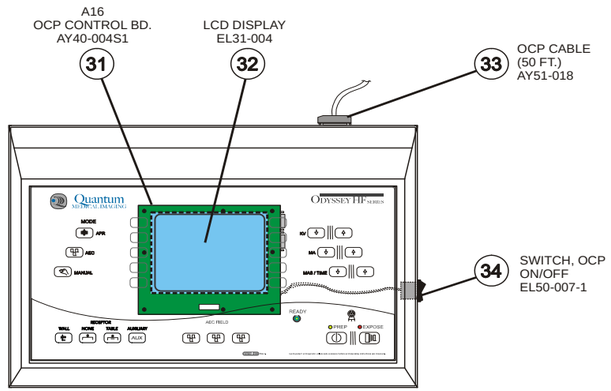
‡NOTE 5: AY40-073S USED ON SYSTEMS EQUIPPED WITH Q-CONNECT OPTION ONLY

Figure 6-5. Three-Phase X-ray Generators, 50, 65 and 80 kW (with QMI-HSS) Parts Location Diagram (Sheet 1 of 2)

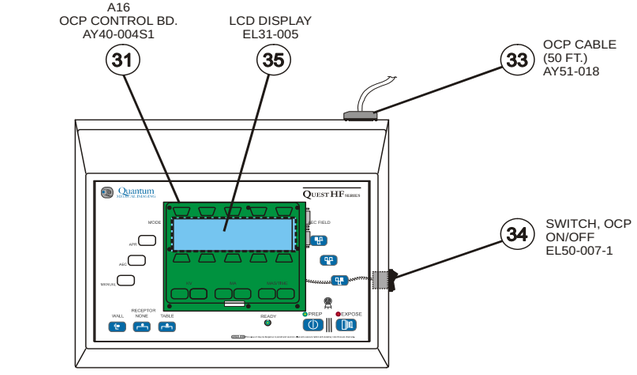
QG-50, QG-50-2, QG-65 AND QG-80 (WITH QMI-HSS HIGH-SPEED STARTER OPTION) THREE-PHASE PARTS LIST

ITEM	DESCRIPTION	PART NUMBER	QTY. USED PER SYSTEM
1	KVP CONTROL BD. (A2)	AY40-003S	1
2	AEC CONTROL BD. (A11), STANDARD TYPE AEC CONTROL BD. (A11), UNIVERSAL TYPE	AY40-031S AY40-027S	1 (OPTION) 1 (OPTION)
3	FILAMENT CONTROL BD. (A5)	AY40-007T	1
4	LOGIC BD. (A1)	AY40-006S	1
5	OCP INTERFACE BD. (A1A1)	AY40-073S	1 (OPTION)
6	POWER SUPPLY BD. (A6)	AY40-005T	1
7	RESISTOR, ALUMIN., 50Ω, 50W (R3A, R3B, R4A, R4B)	EL18-002	4
8	FUSE, AG, SLOW-BLOW, 3.15A (F1, F2)	EL45-025	2
9	HSS CONTROL BD. (A20)	AY40-035S	1
10	CAPACITOR, METALIZED 12 uF, 660V (C2A, C2B)	EL28-045	2
11	* CAPACITOR, METALIZED 440V (C1): 12 uF 15 uF 25 uF 40 uF	 EL28-014 EL28-017 EL28-008 EL28-007	 2* 2* 1* 1*
12	HSS DRIVER BD. (A21)	AY40-036S	1
13	LINE MONITOR BD. (A8)	AY40-053S2 AY40-053S3	1 (MODELS QG-50, QG-65, QG-80) 1 (MODEL QG-50-2)
14	RECTIFIER, 150/130 AMP, 800V (DB1, DB2)	EL32-003	2
15	INTERFACE BD. (A9)	AY40-061T AY40-062T	1 (USED ON NON-DIGITAL RECEPTOR SYSTEMS) 1 (USED ON DIGITAL RECEPTOR SYSTEMS)
16	CAPACITOR, 2400 uF, 450V (C9-C16)	EL26-004	8
17	POWER MODULE (A18, A19)	AY20-047	2
18	IGBT DRIVE BD. (A18A3, A19A3)	AY40-010T	2
19	+28 VDC POWER SUPPLY	EL68-007	1 (OPTION)
20	CIRCUIT BREAKER, 3-POLE, 50 AMP, 600VAC (CB1)	EL70-003	1
21	CAPACITOR, 1 uF, 1500V (C3, C4, C6, C7)	EL22-005	4
22	CAPACITOR, 0.5 uF, 1500V (C5, C8)	EL28-004	2 (NOT USED ON MODEL Q6-50-2)
23	HIGH-VOLTAGE TRANSFORMER (A17)	AY20-031 (125 KV) AY20-032 (150 KV OPTION)	1
24	LINE FILTER, 10 AMP, 250VAC (FL1)	EL99-001	1
25	TERMINAL BLOCK, 3-POSITION (TB2)	EL90-030	4
26	TERMINAL BLOCK, 3-POSITION (TB1)	EL90-009	1
27	CONTACTOR, 4-POLE, 24V (K1 - K3)	EL40-006	3
28	TRANSFORMER, AUTO 3-PHASE (T1A-T1C)	EL55-009 EL55-027	3 (MODELS QG-50, QG-65, QG-80) 3 (MODEL QG-50-2)
29	TRANSFORMER, AUX. AC SUPPLY (T2)	EL55-039	1
30	RESISTOR, ALUMIN., 1.2KOHM, 50W (R1A, R1B, R2A, R2B)	EL18-003	4
31	OCP CONTROL BD. (A16)	AY40-004S1	1
32	LCD DISPLAY (ODYSSEY)	EL31-004	1
33	OCP SERIAL CABLE (50 FT.)	AY51-018	1
34	SWITCH, OCP ON/OFF	EL50-007-1	1
35	LCD DISPLAY (QUEST)	EL31-005	1
NOT SHOWN	ROTOR CABLE (FOR VARIAN TUBES) ROTOR CABLE (TOSHIBA TUBES)	AY51-014V-XX AY51-014T-XX	XX=CABLE LENGTH (FT.)
SUPPLIED W/TABLE	BUCKY POWER CABLE	EL75-025	SPECIFY LENGTH
SUPPLIED W/TUBE STAND	+24 VOLT POWER CABLE	EL75-004	SPECIFY LENGTH

* NOTE: REFER TO CHAPTER 2, ASSEMBLY & INSTALLATION FOR CORRECT PART NOS. & QTY. OF C1 ROTOR CAPACITOR



ODYSSEY OPERATOR CONTROL PANEL (AY10-005)



QUEST OPERATOR CONTROL PANEL (AY10-004)

Figure 6-5. Three-Phase X-ray Generators, 50, 65 and 80 kW (with QMI-HSS) Parts Location Diagram (Sheet 2 of 2)

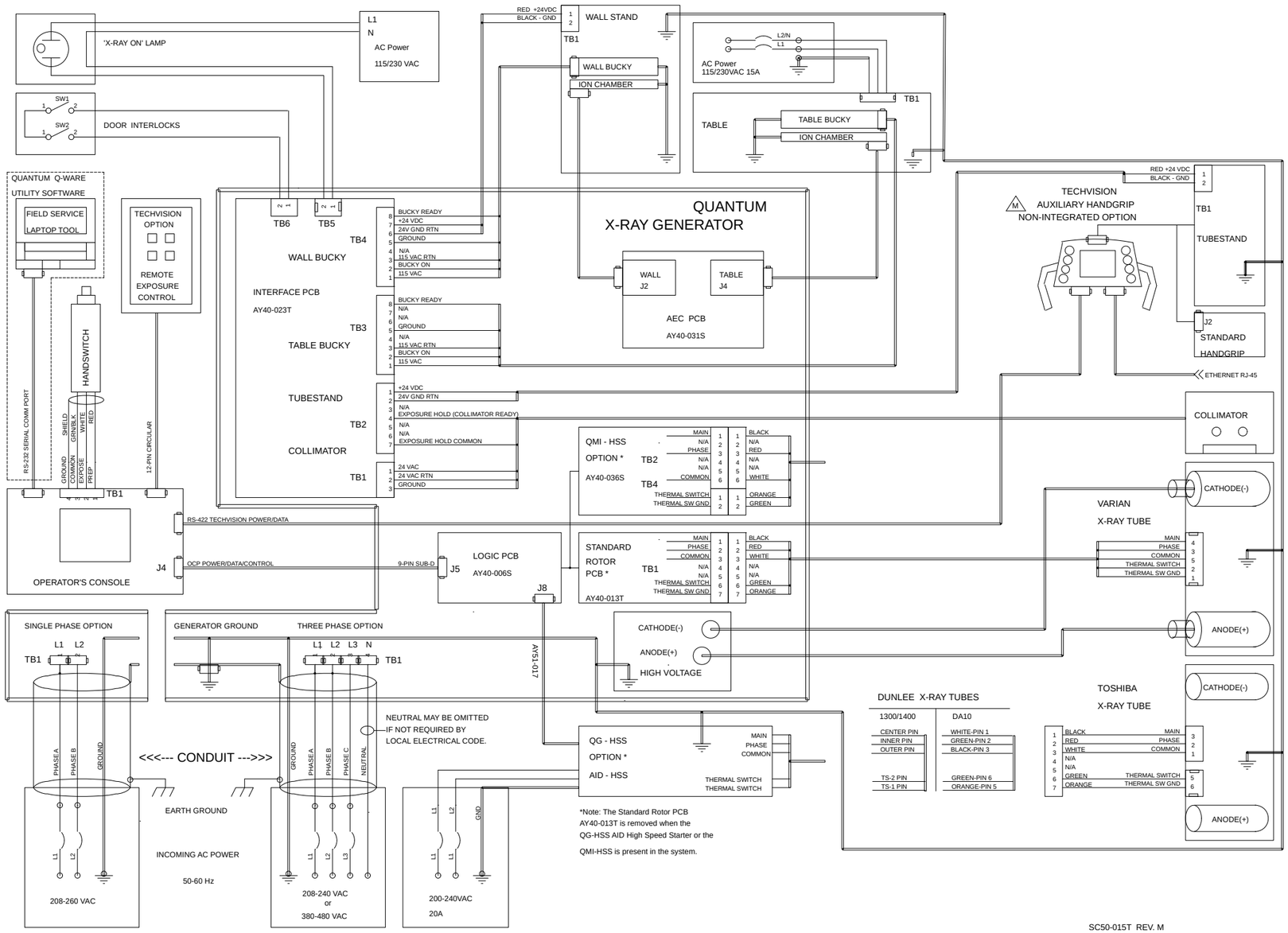


Figure 6-6. Generator System Cabling Diagram (Internal High-Speed Starter)

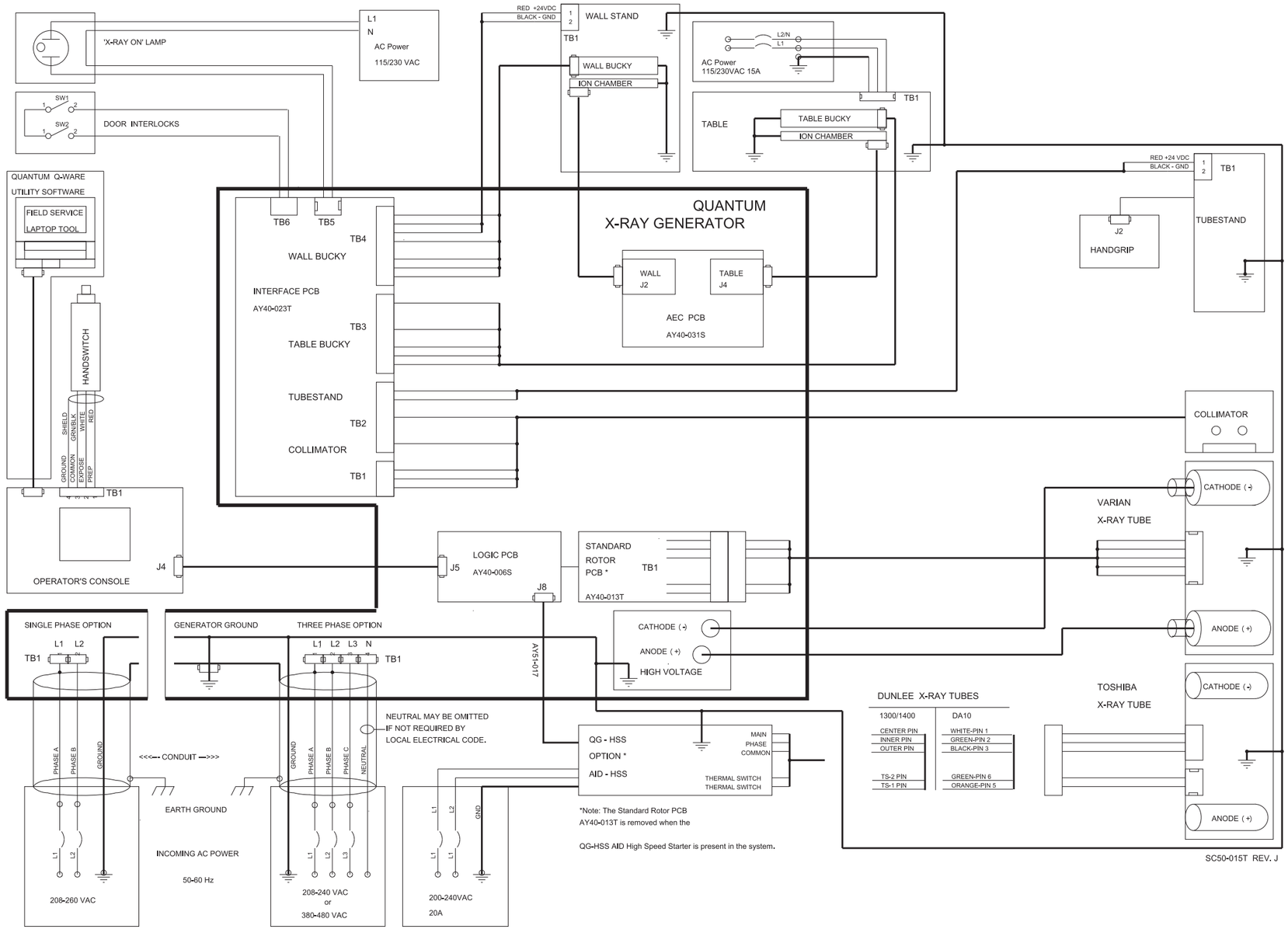


Figure 6-7. Generator System Cabling Diagram (External High-Speed Starter Systems)

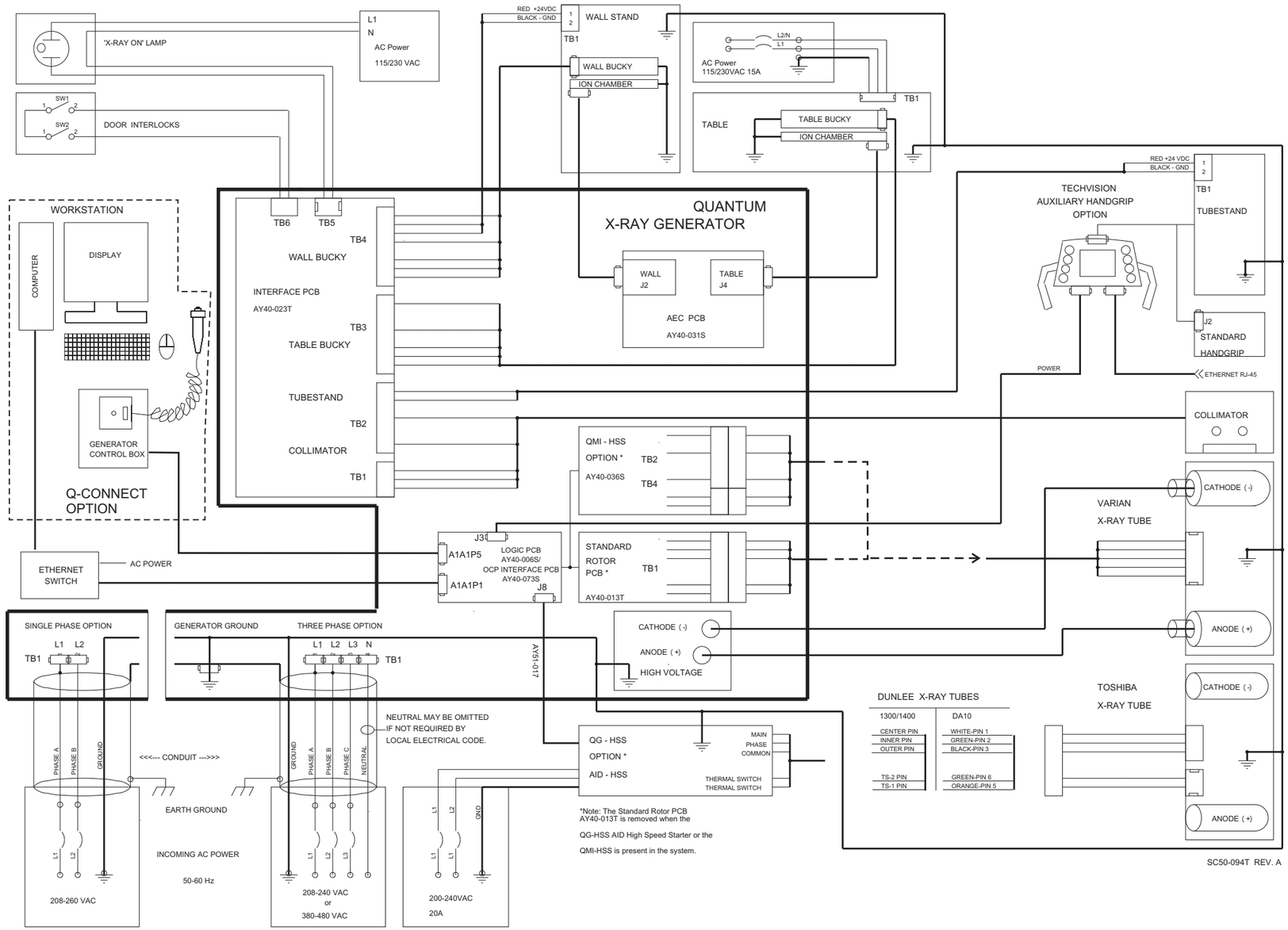


Figure 6-8. System Cabling Diagram (with Q-Connect Option)

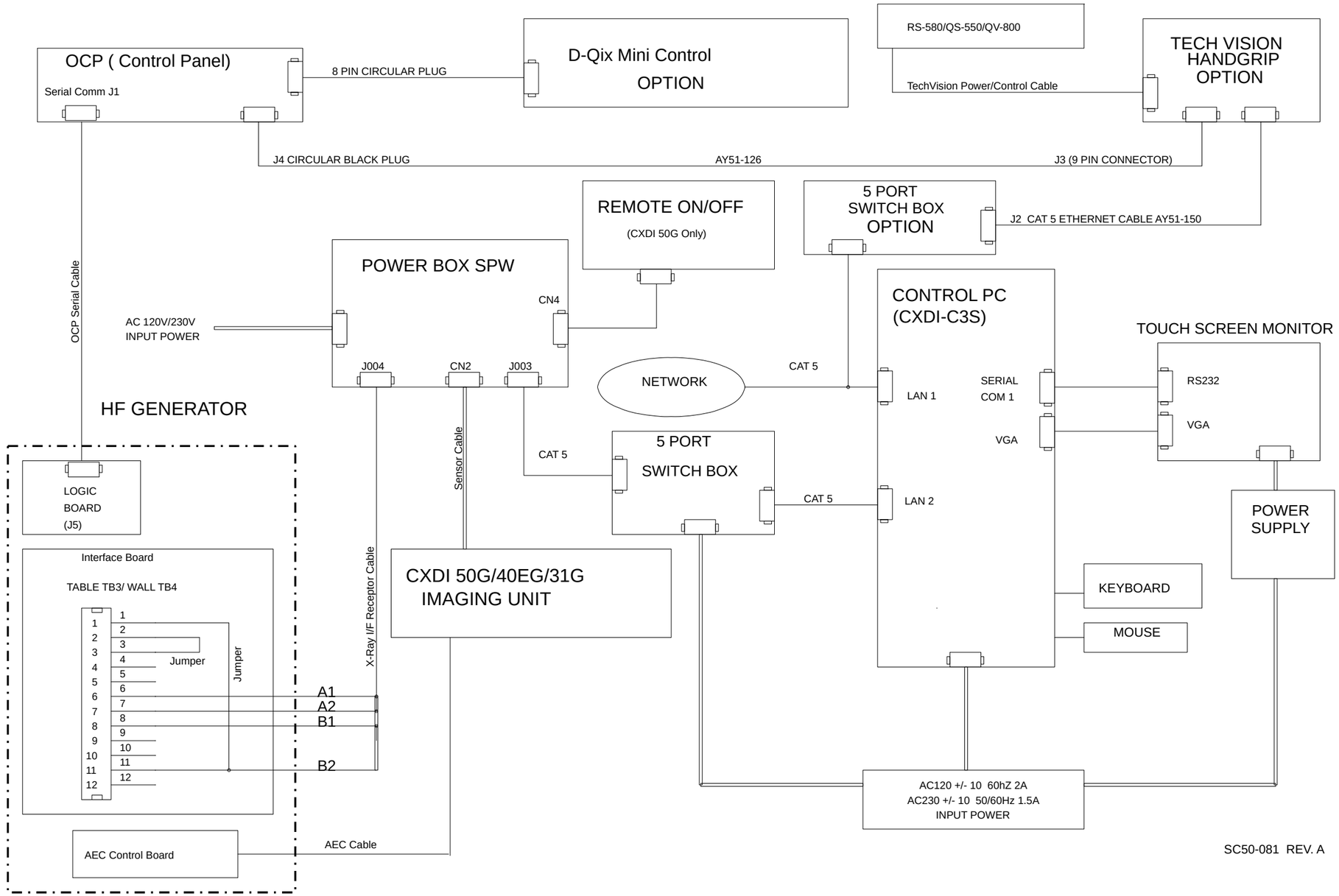


Figure 6-9. HF Generator to Canon/TechVision System Interconnection Diagram (Non-Widescreen)

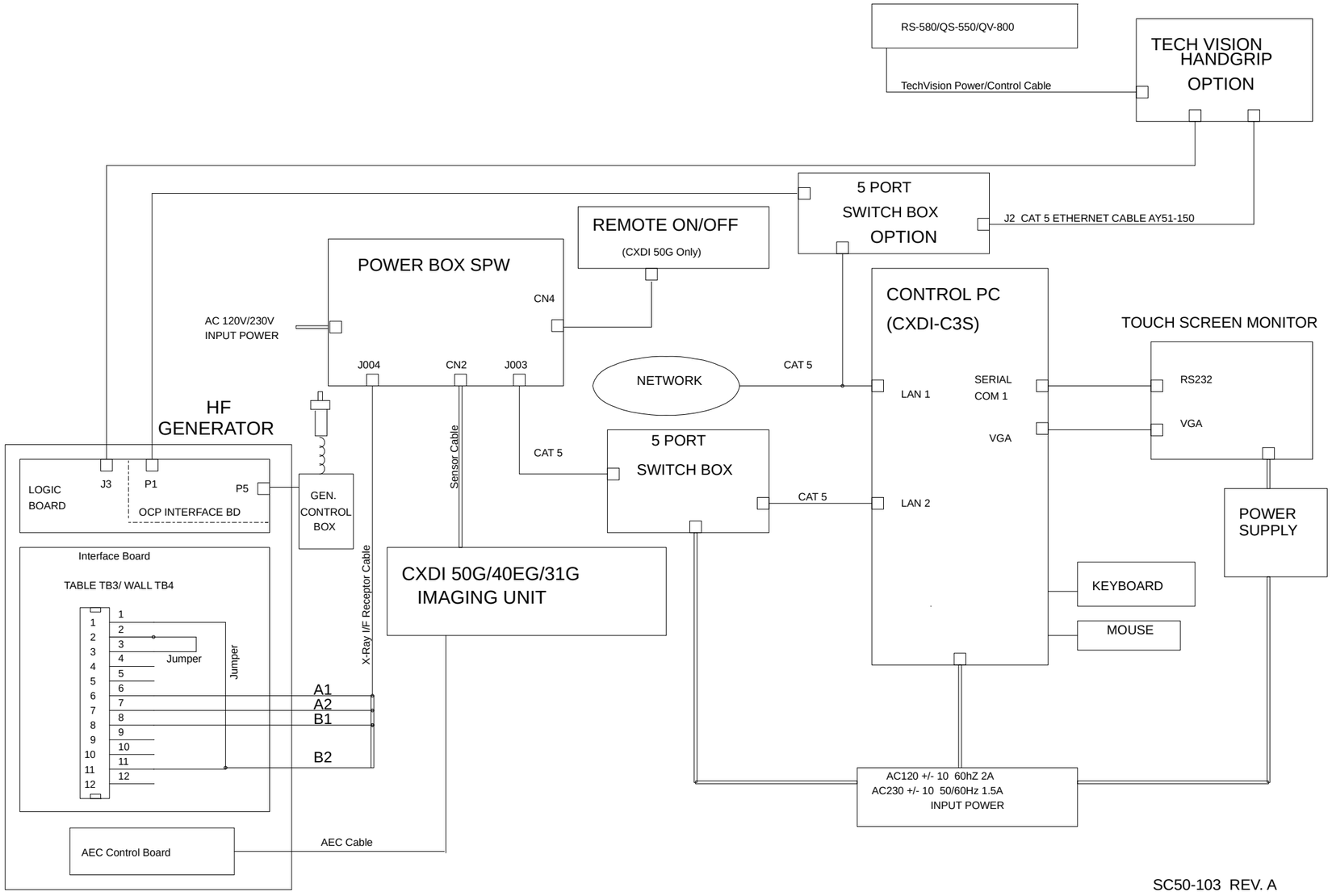
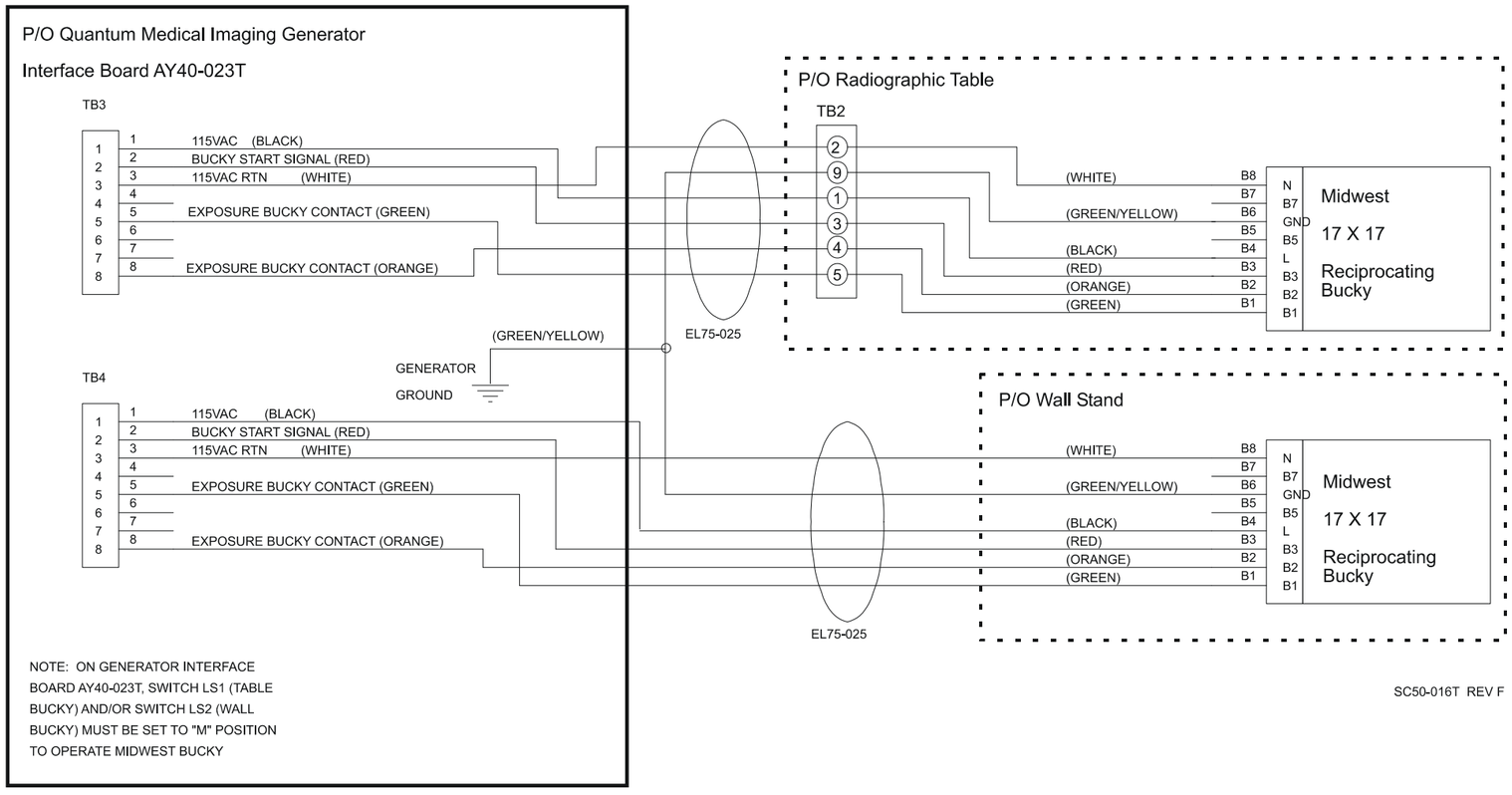
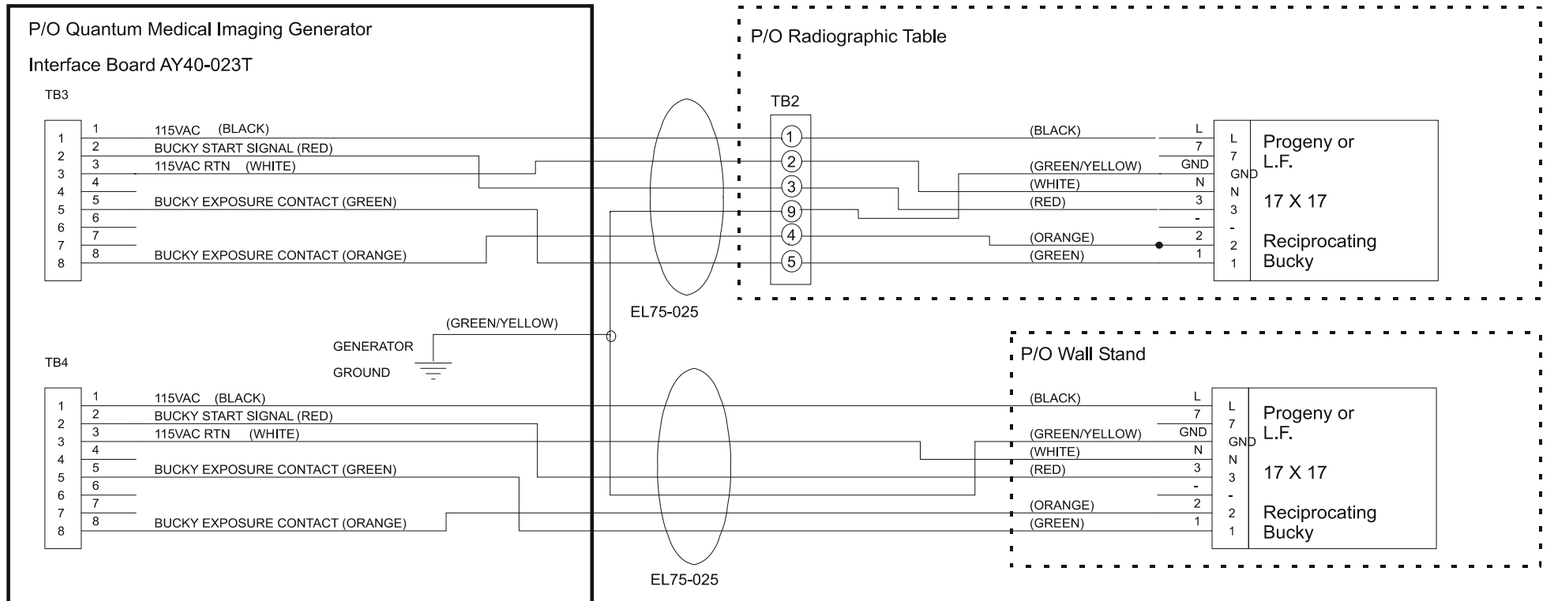


Figure 6-10. HF Generator to Canon/TechVision System Interconnection Diagram (Widescreen)



NOTE:
ON SYSTEMS USING FOUR (4) WIRE MULTI-CONDUCTOR BUCKY CABLE, CONNECT "BUCKY ON" SIGNAL (RED WIRE) TO LINE (B4) TERMINAL ON BUCKY. (THE 115VAC (BLACK WIRE) CONNECTION

Figure 6-11. 17 x 17 Midwest Bucky Interconnection Diagram



NOTE:
ON SYSTEMS USING FOUR (4) WIRE MULTI-CONDUCTOR BUCKY CABLE, CONNECT "BUCKY ON" SIGNAL (RED WIRE) TO LINE (L) TERMINAL ON BUCKY. (THE 115VAC (BLACK WIRE) CONNECTION

Figure 6-12. 17 x 17 Progeny and L-F Bucky Interconnection Diagram

14 X 36 MIDWEST BUCKY

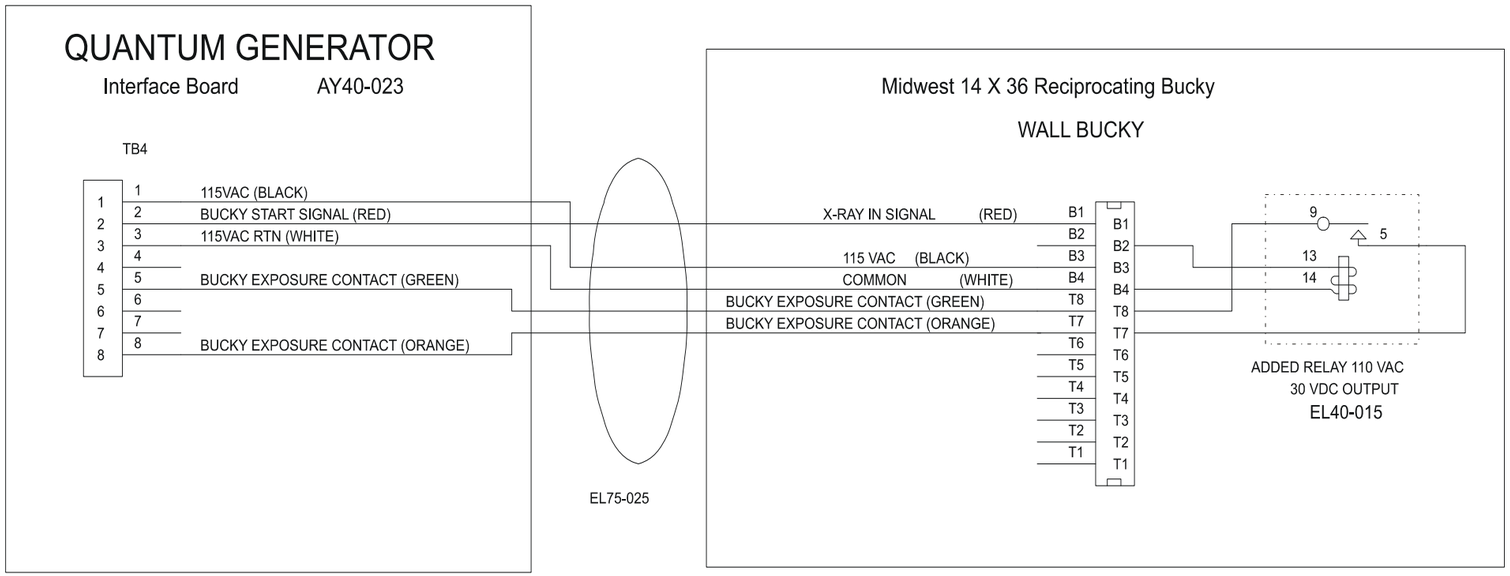


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Figure 6-13. 14 x 36 Midwest Bucky Interconnection Diagram

X-RAY TUBE ROTOR CONNECTION CHART		
TOSHIBA	VARIAN	DUNLEE
1- COMM.	5- COMM.	OUTER- COMM.
2- MAIN	4- MAIN	CENTER- MAIN
3- PHASE	3- PHASE	INNER- PHASE
5- T.S.	1- T.S.	T.S.-1
6- T.S.	2- T.S.	T.S.-2

NOTES:
1. C9 THRU C16 2400µF 450VDC.

2. C3, C4, C6 AND C7 1µF 1500V. C5 AND C8 NOT USED.

3. C1 VALUE COULD CHANGE DEPENDING ON TUBE MANUFACTURER OR MODEL. (SEE TUBE DATA SHEET).

4. DISCONNECT A17P1-9 AND 10 FROM GROUND AND CONNECT MAS METER TO THESE WIRES. (WARNING A17P1-9 AND 10 MUST BE CONNECTED TO GROUND OR MAS METER.)

5. AY51-019-2 IS USED FOR AEC OPTION ONLY. NON AEC GENERATORS USE AY51-019-1.

6. 40KW SYSTEMS CB1 MUST BE 70 AMP. 32.5 AMP AND 25 KW SYSTEMS CB1 MUST BE 50AMP.

7. ADJUST THESE JUMPERS TO THE NEAREST INCOMING AC LINE INPUT.

Figure 6-14. Single-Phase 208 - 260 VAC Input (Non-STORED ENERGY) X-ray Generators, 25, 32 and 40 kW Interconnection Diagram

X-RAY TUBE ROTOR CONNECTION CHART		
TOSHIBA	VARIAN	DUNLEE
1- COMM.	5- COMM.	OUTER- COMM.
2- MAIN	4- MAIN	CENTER- MAIN
3- PHASE	3- PHASE	INNER- PHASE
5- T.S.	1- T.S.	T.S.-1
6- T.S.	2- T.S.	T.S.-2

NOTES:

1. C9 THRU C16 2400UF 450VDC
2. C3,C4,C6 AND C7 1UF 1500V
   C5 AND C8 NOT USED
3. C1 VALUE COULD CHANGE DEPENDING ON TUBE MANUFACTURER OR MODEL. (SEE TUBE DATA SHEET)
4. DISCONNECT A17P1-9 AND 10 FROM GROUND AND CONNECT MAS METER TO THESE WIRES. (WARNING A17P1-9 AND 10 MUST BE CONNECTED TO GROUND OR MAS METER)
5. AY51-019-2 IS USED FOR AEC OPTION ONLY. NON AEC GENERATORS USE AY51-019-1
6. 40 AND 32 KW SYSTEMS CB1 MUST BE 50 AMP/3 POLES 25 KW SYSTEMS CB1 MUST BE 30AMP/ 3 POLES
7. ADJUST THESE JUMPERS TO THE NEAREST INCOMING AC LINE INPUT.

Figure 6-15. Single-Phase 380 - 480 VAC Input (Non-STORED ENERGY) X-ray Generators, 25, 32 and 40 kW Interconnection Diagram

X-RAY TUBE ROTOR CONNECTION CHART		
TOSHIBA	VARIAN	DUNLEE
1- COMM.	5- COMM.	OUTER- COMM.
2- MAIN	4- MAIN	CENTER- MAIN
3- PHASE	3- PHASE	INNER- PHASE
5- T.S.	1- T.S.	T.S.-1
6- T.S.	2- T.S.	T.S.-2

NOTES:

1. C9, THRU C12, 2400 UF/ 450VDC
2. C3, C6, 1UF 1500V
3. C4,C7 .5UF 1500V
4. C1 VALUE COULD CHANGE DEPENDING ON TUBE MANUFACTURER OR MODEL. (SEE TUBE DATA SHEET)
5. DISCONNECT A17P1-9 AND10 FROM GROUND AND CONNECT MAS METER TO THESE WIRES (WARNING A17P1-9 AND 10 BE CONNECTED TO GROUND OR TO THE MAS METER.)
6. AY51-019-2 IS USED FOR AEC OPTION ONLY. NON AEC GENERATORS USE AY51-019-1.
7. ADJUST THESE JUMPERS TO THE NEAREST INCOMING AC LINE.

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Figure 6-16. Single-Phase (STORED ENERGY) X-ray Generator, 20 kW Interconnection Diagram

X-RAY TUBE ROTOR CONNECTION CHART		
TOSHIBA	VARIAN	DUNLEE
1- COMM.	5- COMM.	OUTER- COMM.
2- MAIN	4- MAIN	CENTER- MAIN
3- PHASE	3- PHASE	INNER- PHASE
5- T.S.	1- T.S.	T.S.-1
6- T.S.	2- T.S.	T.S.-2

NOTES:

1. C8, THRU C15, 2400 UF/ 450VDC.
2. C1 VALUE COULD CHANGE DEPENDING ON TUBE MANUFACTURER OR MODEL. (SEE TUBE DATA SHEET)
3. DISCONNECT A17P1-9 AND #10 FROM GROUND AND CONNECT THE MAS METER ACROSS THESE WIRES (WARNING A17P1-9 AND 10 MUST BE CONNECTED TO GROUND OR TO THE MAS METER.)
4. AY51-019-2 AND AY51-020 ARE USED FOR AEC OPTION ONLY. NON AEC GENERATORS AY51-020 IS NOT INSTALLED AND AY51-019-2 IS REPLACED WITH AY51-019-1.
5. ADJUST THESE JUMPERS TO THE NEAREST INCOMING AC LINE VOLTAGE.
6. CAPACITORS VALUES: C3,C4,C4A,C6,C7,C7A FOR THE FAMILY OF SE GEN.

SE GEN.	C3	C4	C4A	C6	C7	C7A
32KW	1uF	0.5uF	——	1uF	0.5uF	——
40KW	1uF	1uF	——	1uF	1uF	——
50KW	1uF	1uF	0.25uF	1uF	1uF	0.25uF

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Figure 6-17. Single-Phase (STORED ENERGY) X-ray Generators, 32, 40 and 50 kW Interconnection Diagram

X-RAY TUBE ROTOR CONNECTION CHART		
TOSHIBA	VARIAN	DUNLEE
1- COMM.	5- COMM.	OUTER- COMM.
2- MAIN	4- MAIN	CENTER- MAIN
3- PHASE	3- PHASE	INNER- PHASE
5- T.S.	1- T.S.	T.S.-1
6- T.S.	2- T.S.	T.S.-2

NOTES:

1. C3, C4 ,C6 AND C7 1UF/1500VAC
2. C5 AND C8 ARE NOT INSTALLED.
3. C9 THRU C16, 2400UF/450VDC
4. DISCONNECT A17P1-9 AND 10 FROM GROUND AND CONNECT THE MAS METER TO THESE WIRES. (WARNING A17P1-9 AND 10 MUST BE CONNECTED TO GROUND OR MAS METER.)
5. C1 VALUE COULD CHANGE DEPENDING ON TUBE MANUFACTURER OR MODEL (SEE TUBE DATA BASE)
6. 32 AND 40KW GENERATORS CB1 MUST BE 30 AMP. 50kW GENERATORS CB1 MUST BE 50 AMP.
7. AY51-019-2 IS USED FOR AEC OPTION ONLY. NON AEC GENERATORS USE AY51-019-1.
8. ADJUST THESE JUMPERS TO THE NEAREST INCOMING AC LINE INPUT.

Figure 6-18. Three-Phase (380-480) Input (32, 40 and 50 kW without High Speed Starter) X-ray Generators Interconnection Diagram

X-RAY TUBE ROTOR CONNECTION CHART		
TOSHIBA	VARIAN	DUNLEE
1- COMM.	5- COMM.	OUTER- COMM.
2- MAIN	4- MAIN	CENTER- MAIN
3- PHASE	3- PHASE	INNER- PHASE
5- T.S.	1- T.S.	T.S.-1
6- T.S.	2- T.S.	T.S.-2

NOTES:

1. C3, C4 ,C6 AND C7 1UF/1500VAC.
2. C5 AND C8 ARE NOT INTALLED
3. C9 THRU C16, 2400UF/450VDC
4. DISCONNECT A17P1-9 AND 10 FROM GROUND AND CONNECT THE MAS METER TO THESE WIRES. (WARNING A17P1-9 AND 10 MUST CONNECTED TO GROUND OR MAS METER.)
5. C1 VALUE COULD CHANGE DEPENDING ON TUBE MANUFACTURER OR MODEL (SEE TUBE DATA BASE)
6. AY51-019-2 IS USED FOR AEC OPTION ONLY. NON AEC GENERATORS USE AY51-019-1.
7. ADJUST THESE JUMPERS TO THE NEAREST INCOMING AC LINE INPUT.

Figure 6-19. Three-Phase (208-240) Input (32, 40 and 50 kW without High Speed Starter) X-ray Generators Interconnection Diagram

X-RAY TUBE ROTOR CONNECTION CHART		
TOSHIBA	VARIAN	DUNLEE
1- COMM.	5- COMM.	OUTER- COMM.
2- MAIN	4- MAIN	CENTER- MAIN
3- PHASE	3- PHASE	INNER- PHASE
5- T.S.	1- T.S.	T.S.-1
6- T.S.	2- T.S.	T.S.-2

NOTES:

1. C3, C4, C6 AND C7 1UF/1500VAC C5 AND C8, .5 UF/1500VAC.
2. DO NOT INSTALL C5 AND C8 IN 50KW GENERATORS.
3. C9 THRU C16, 2400UF/450VDC
4. DISCONNECT A17P1-9 AND 10 AND CONNECT THE MAS METER TO THESE WIRES. (WARNING A17P1-9 AND 10 MUST BE CONNECTED TO GROUND OR TO MAS METER.)
5. 50 KW GENERATOR STANDARD HV MODULE IS AY30-031 125 KV
6. AY51-019-2 IS USED FOR AEC OPTION ONLY, NON AEC GENERATORS USE AY51-019-1
7. DIGITAL GENERATOR, AY40-023T IS REPLACED WITH AY40-034T. AY51-089 CABLE IS USED WITH AY40-034T BD. ONLY FOR DIGITAL GENERATOR WITH STANDARD AEC.
8. ADJUST THESE JUMPERS TO THE NEAREST INCOMING AC LINE INPUT.

Figure 6-20. Three-Phase (50, 65 and 80 kW with AID High Speed Starter) X-ray Generators Interconnection Diagram

X-RAY TUBE ROTOR CONNECTION CHART		
TOSHIBA	VARIAN	DUNLEE
1- COMM.	5- COMM.	OUTER- COMM.
2- MAIN	4- MAIN	CENTER- MAIN
3- PHASE	3- PHASE	INNER- PHASE
5- T.S.	1- T.S.	T.S.-1
6- T.S.	2- T.S.	T.S.-2

NOTES:

1. C3, C4, C6 AND C7 1UF/1500VAC, C5 AND C8 ARE NOT USED
2. C1 VALUE COULD CHANGE DEPENDING ON TUBE MODEL (SEE TUBE DATA SHEET)
3. C9 THRU C16, 2400UF/450VDC
4. DISCONNECT A17P1-9 AND 10 AND CONNECT THE MAS METER TO THESE WIRES. (WARNING A17P1-9 AND 10 MUST BE CONNECTED TO GROUND OR TO MAS METER.)
5. DIGITAL GENERATOR, AY40-023T IS REPLACED WITH AY40-034T.
6. GENERATORS WITH TOMO OPTION, AY40-006S MUST BE REV F OR HIGHER
7. GENERATOR WITHOUT DIGITAL RECEPTOR OPTION AY51-090 IS REPLACED WITH AY51-048.
8. 32 AND 40 KW GENERATORS MUST BE 30 AMP. 50 KW GENERATORS MUST BE 50 AMP.
9. ADJUST THESE JUMPERS TO THE NEAREST INCOMING AC LINE INPUT.

Figure 6-21. Three-Phase (32, 40 and 50 kW without High Speed Starter, with Universal AEC Board) X-ray Generators Interconnection Diagram

X-RAY TUBE ROTOR CONNECTION CHART		
TOSHIBA	VARIAN	DUNLEE
1- COMM.	5- COMM.	OUTER- COMM.
2- MAIN	4- MAIN	CENTER- MAIN
3- PHASE	3- PHASE	INNER- PHASE
5- T.S.	1- T.S.	T.S.-1
6- T.S.	2- T.S.	T.S.-2

NOTES:

1. C3, C4, C6 AND C7 1UF/1500VAC, C5 AND C8 .5 UF/1500VAC
2. DO NOT INSTALL C5 AND C8 IN 50KW GENERATORS.
3. C9 THRU C16, 2400UF/450VDC
4. DISCONNECT A17P1-9 AND 10 AND CONNECT (WARNING A17P1-9 AND 10 MUST BE CONNECTED TO GROUND OR TO MAS METER.) THE MAS METER TO THESE WIRES
5. 50 KW GENERATOR STANDARD HV MODULE IS AY30-031, 125 KV
6. DIGITAL GENERATOR, AY40-023T IS REPLACED WITH AY40-034T
7. GENERATORS WITH TOMO OPTION, AY40-006S MUST BE REV F OR HIGHER
8. GENERATOR WITH UNIVERSAL AEC AND DIGITAL RECEPTOR AY51-048 IS REPLACED WITH AY51-090
9. ADJUST THESE JUMPERS TO THE NEAREST INCOMING AC LINE INPUT.

Figure 6-22. Three-Phase (65 and 80 kW with AID High Speed Starter, Universal AEC Board) X-ray Generators Interconnection Diagram

X-RAY TUBE ROTOR CONNECTION CHART		
TOSHIBA	VARIAN	DUNLEE
1- COMM.	5- COMM.	OUTER- COMM.
2- MAIN	4- MAIN	CENTER- MAIN
3- PHASE	3- PHASE	INNER- PHASE
5- T.S.	1- T.S.	T.S.-1
6- T.S.	2- T.S.	T.S.-2

NOTES:

1. C3, C4, C6 AND C7 1UF/1500VAC, C5 AND C8 ARE NOT USED
2. C1 VALUE COULD CHANGE DEPENDING ON TUBE MODEL (SEE TUBE DATA SHEET)
3. C9 THRU C16, 2400UF/450VDC
4. DISCONNECT A17P1-9 AND 10 AND CONNECT THE MAS METER TO THESE WIRES. (WARNING A17P1-9 AND 10 MUST BE CONNECTED TO GROUND OR TO MAS METER.)
5. DIGITAL GENERATOR, AY40-023T IS REPLACED WITH AY40-034T.
6. GENERATORS WITH TOMO OPTION, AY40-006S MUST BE REV F OR HIGHER
7. GENERATOR WITH UNIVERSAL AEC AND DIGITAL RECEPTOR, AY51-048 IS REPLACED WITH AY51-090.
8. ADJUST THESE JUMPERS TO THE NEAREST INCOMING AC LINE INPUT.

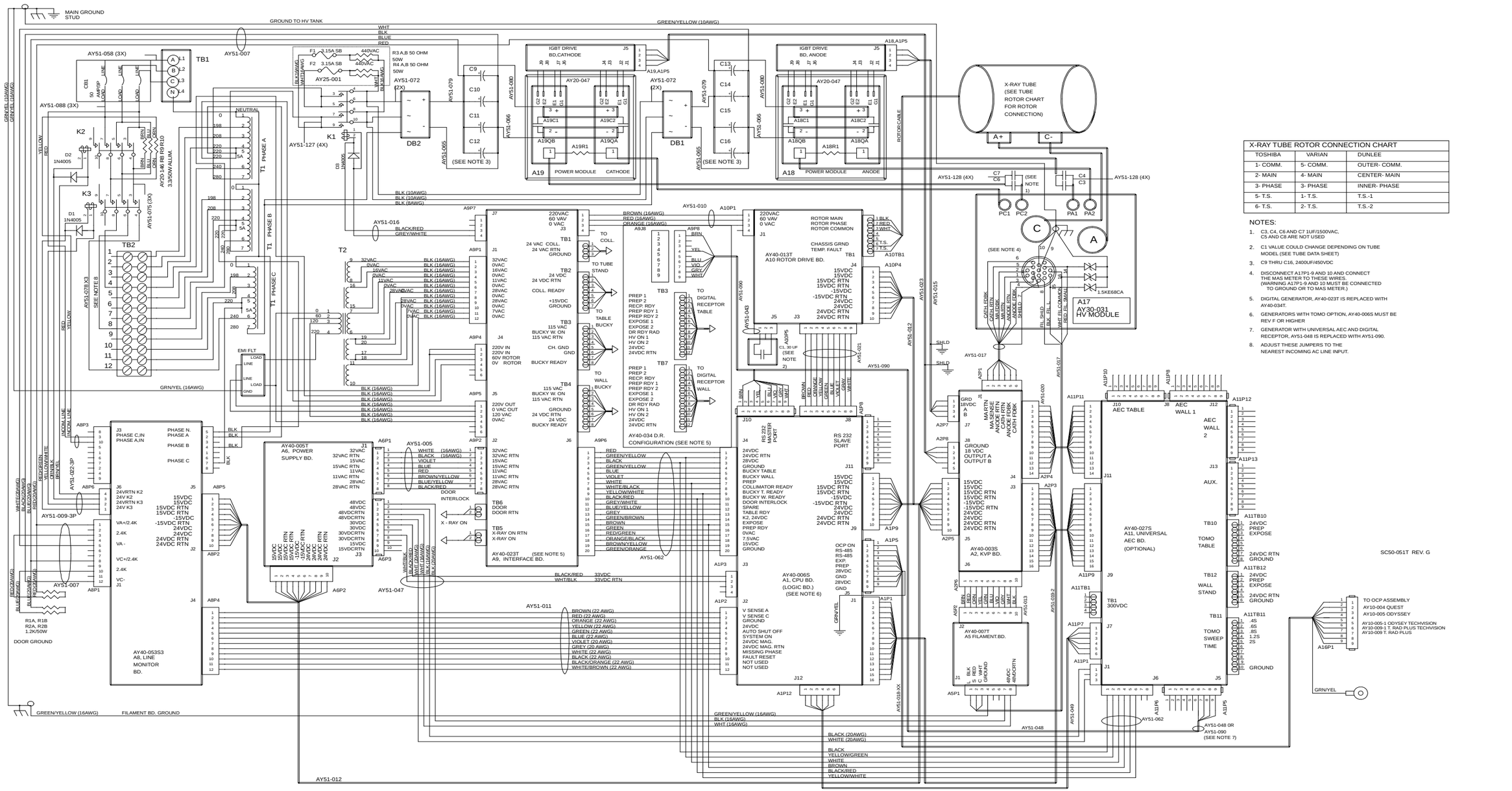

Figure 6-23. Three-Phase (208-240) Input (32, 40 and 50 kW without High Speed Starter, with Universal AEC Board) X-ray Generators Interconnection Diagram

X-RAY TUBE ROTOR CONNECTION CHART		
TOSHIBA	VARIAN	DUNLEE
1- COMM.	5- COMM.	OUTER- COMM.
2- MAIN	4- MAIN	CENTER- MAIN
3- PHASE	3- PHASE	INNER- PHASE
5- T.S.	1- T.S.	T.S.-1
6- T.S.	2- T.S.	T.S.-2

NOTES:

1. C9 THRU C16, 2400uF/450VDC
2. C3, C6 1uF/1500V, C4,C7 .5uF/1500V C5 AND C8 ARE NOT INSTALLED
3. C1 VALUE COULD CHANGE DEPENDING ON TUBE MANUFACTURER OR MODEL, (SEE TUBE DATA BASE)
4. DISCONNECT A17P1-9,-10 AND CONNECT THE MAS METER TO THESE WIRES. (WARNING A17P1-9 AND -10 MUST BE CONNECTED
5. AY40-062T INTERFACE BOARD IS USED ON Q-HSS DIGITAL GENERATOR ONLY, Q-HSS NON DIGITAL GENERATOR USE AY40-061T.
6. AY51-019-2 IS USED FOR AEC OPTION ONLY, NON AEC GENERATORS USE AY51-019-1.
7. USE CABLE AY51-151 CABLE FOR INTERFACING TO RS-580 SYSTEM:
   - CONNECT WIRES FROM P81-7, -8 TO P2-1
   - CONNECT WIRES FROM P81-4, -5 TO P2-2
   - CONNECT WIRE FROM P81-4 TO GND
   - CONNECT WIRE FROM P81-1 INTERFACE BOARD A9TB1-2
   - CONNECT WIRE FROM P81-2 TO INTERFACE BOARD A9TB1-1
   - CONNECT WIRE FROM P81-3 TO INTERFACE BOARD A9TB1-3

   FOR SYSTEMS OTHER THAN RS-580 CONSULT RESPECTIVE MANUALS
8. ADJUST THESE JUMPERS TO THE NEAREST INCOMING AC LINE INPUT.

Figure 6-24. Three-Phase (208-240) Input (50 kW with QMI High Speed Starter) X-ray Generator Interconnection Diagram

X-RAY TUBE ROTOR CONNECTION CHART # 1		
TOSHIBA	VARIAN	DUNLEE
1- COMM.	5- COMM.	OUTER- COMM.
2- MAIN	4- MAIN	CENTER- MAIN
3- PHASE	3- PHASE	INNER- PHASE
5- T.S.	1- T.S.	T.S.-1
6- T.S.	2- T.S.	T.S.-2

NOTES:

1. C9 THRU C16, 2400uF/450VDC.
2. C3, C6 1uF/1500V, C4,C7 .5uF/1500V
   C5 AND C8 ARE NOT INSTALLED
3. C1 COULD CHANGE DEPENDING ON TUBE MODEL AND MANUFACTURER. (SEE TUBE DATA BASE)
4. DISCONNECT A17P1-9 AND -10 AND CONNECT THE MAS METER TO THESE WIRES. (WARNING A17P1-9 AND -10 MUST BE CONNECTED TO GROUND OR TO MAS METER.)
5. AY40-062T INTERFACE BOARD IS USED ON Q-HSS DIGITAL GENERATOR ONLY. Q-HSS NON DIGITAL GENERATOR USE AY40-061T.
6. DIGITAL GENERATORS WITH NO TOMO OPTION
   AY51-062 IS REPLACED WITH AY51-008 AND AY51-090 IS REPLACED WITH AY51-089.
   NON DIGITAL GENERATOR WITH TOMO OPTION AY51-090 IS REPLACED WITH AY51-048.
7. USE CABLE AY51-151 CABLE FOR INTERFACING TO RS-580 SYSTEM:
   - CONNECT WIRES FROM P81-7,-8 TO P2-1
   - CONNECT WIRES FROM P81-4,-5 TO P2-2
   - CONNECT WIRE FROM P81-4 TO GND
   - CONNECT WIRE FROM P81-1 INTERFACE BOARD A9TB1-2
   - CONNECT WIRE FROM P81-2 TO INTERFACE BOARD A9TB1-1
   - CONNECT WIRE FROM P81-3 TO INTERFACE BOARD A9TB1-3

   FOR SYSTEMS OTHER THAN RS-580 CONSULT RESPECTIVE MANUALS
8. ADJUST THESE JUMPERS TO THE NEAREST INCOMING AC LINE INPUT.

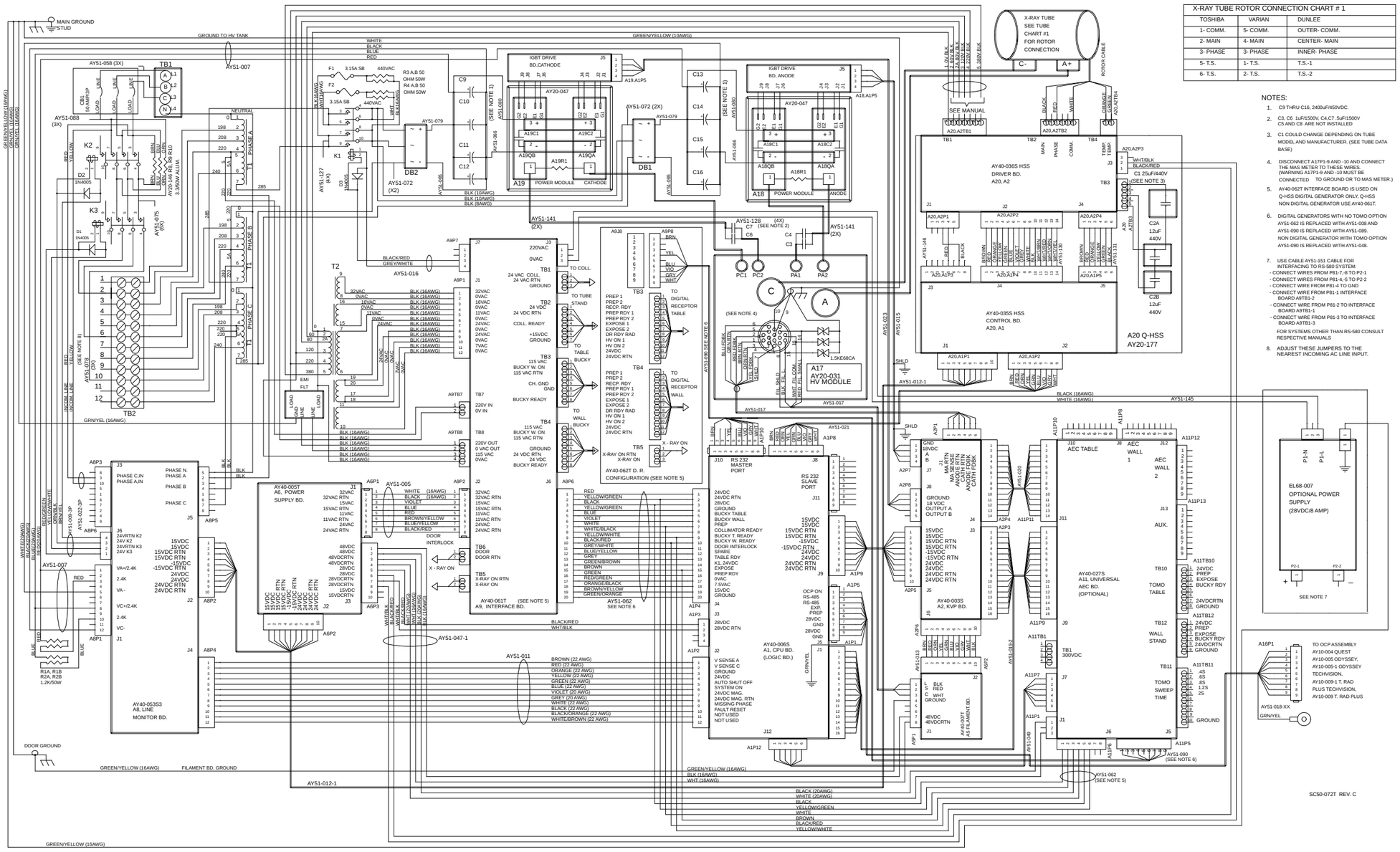

Figure 6-25. Three-Phase (208-240) Input (50 kW with QMI High Speed Starter and Tomography Interface) X-ray Generator Interconnection Diagram

X-RAY TUBE ROTOR CONNECTION CHART #1		
TOSHIBA	VARIAN	DUNLEE
1- COMM.	5- COMM.	OUTER- COMM.
2- MAIN	4- MAIN	CENTER- MAIN
3- PHASE	3- PHASE	INNER- PHASE
5- T.S.	1- T.S.	T.S.-1
6- T.S.	2- T.S.	T.S.-2

NOTES:

1. C9 THRU C16, 2400uF/450VDC
2. C3, C4, C6 AND C7 1uF/1500VAC
   C5 AND C8, .5 uF/1500V
   DO NOT INSTALL C4 AND C7 IN 50KW GENERATORS
3. C1 VALUE COULD CHANGE DEPENDING ON TUBE MANUFACTURER OR MODEL. (SEE TUBE DATA BASE)
4. DISCONNECT A17P1-9,-10 AND CONNECT THE MAS METER TO THESE WIRES. (WARNING A17P1-9 AND -10 MUST BE CONNECTED
5. AY40-062T INTERFACE BOARD IS USED ON Q-HSS DIGITAL GENERATOR ONLY. Q-HSS NON DIGITAL GENERATOR USE AY40-061T
6. AY51-019-2 IS USED FOR AEC OPTION ONLY, NON AEC GENERATORS USE AY51-019-1
7. 50 KW GENERATOR STANDARD HV MODULE IS AY30-031 125 KV
8. USE CABLE AY51-151 CABLE FOR INTERFACING TO RS-580 SYSTEM:
   - CONNECT WIRES FROM P81-7,-8 TO P2-1
   - CONNECT WIRES FROM P81-4,-5 TO P2-2
   - CONNECT WIRE FROM P81-4 TO GND
   - CONNECT WIRE FROM P81-1 INTERFACE BOARD A9TB1-2
   - CONNECT WIRE FROM P81-2 TO INTERFACE BOARD A9TB1-1
   - CONNECT WIRE FROM P81-3 TO INTERFACE BOARD A9TB1-3

   FOR SYSTEMS OTHER THAN RS-580 CONSULT RESPECTIVE MANUALS
9. ADJUST THESE JUMPERS TO THE NEAREST INCOMING AC LINE INPUT.

Figure 6-26. Three-Phase (65 and 80 kW with QMI High Speed Starter) X-ray Generator Interconnection Diagram

X-RAY TUBE ROTOR CONNECTION CHART # 1		
TOSHIBA	VARIAN	DUNLEE
1- COMM.	5- COMM.	OUTER- COMM.
2- MAIN	4- MAIN	CENTER- MAIN
3- PHASE	3- PHASE	INNER- PHASE
5- T.S.	1- T.S.	T.S.-1
6- T.S.	2- T.S.	T.S.-2

NOTES:

1. C9 THRU C16, 2400uF/450VDC.
2. C3, C4, C6 AND C7 1uF/1500VAC.
   C5 AND C8 .5 uF/1500VAC.
   DO NOT INSTALL C4 AND C7 IN 50KW GENERATORS.
3. C1 COULD CHANGE DEPENDING ON TUBE MODEL AND MANUFACTURER. (SEE TUBE DATA BASE)
4. DISCONNECT A17P1-9 AND -10 AND CONNECT THE MAS METER TO THESE WIRES. (WARNING A17P1-9 AND -10 MUST BE CONNECTED TO GROUND OR TO MAS METER.)
5. AY40-062T INTERFACE BOARD IS USED ON Q-HSS DIGITAL GENERATOR ONLY. Q-HSS NON DIGITAL GENERATOR USE AY40-061T.
6. DIGITAL GENERATORS WITH NO TOMO OPTION AY51-062 IS REPLACED WITH AY51-008 AND AY51-090 IS REPLACED WITH AY51-089. NON DIGITAL GENERATOR WITH TOMO OPTION AY51-090 IS REPLACED WITH AY51-048.
7. 50 KW GENERATOR STANDARD HV MODULE IS AY30-031, 125 KV.
8. USE CABLE AY51-151 CABLE FOR INTERFACING TO RS-580 SYSTEM:
   - CONNECT WIRES FROM P81-7,-8 TO P2-1
   - CONNECT WIRES FROM P81-4,-5 TO P2-2
   - CONNECT WIRE FROM P81-4 TO GND
   - CONNECT WIRE FROM P81-1 INTERFACE BOARD A9TB1-2
   - CONNECT WIRE FROM P81-2 TO INTERFACE BOARD A9TB1-1
   - CONNECT WIRE FROM P81-3 TO INTERFACE BOARD A9TB1-3
   FOR SYSTEMS OTHER THAN RS-580 CONSULT RESPECTIVE MANUALS
9. ADJUST THESE JUMPERS TO THE NEAREST INCOMING AC LINE INPUT.

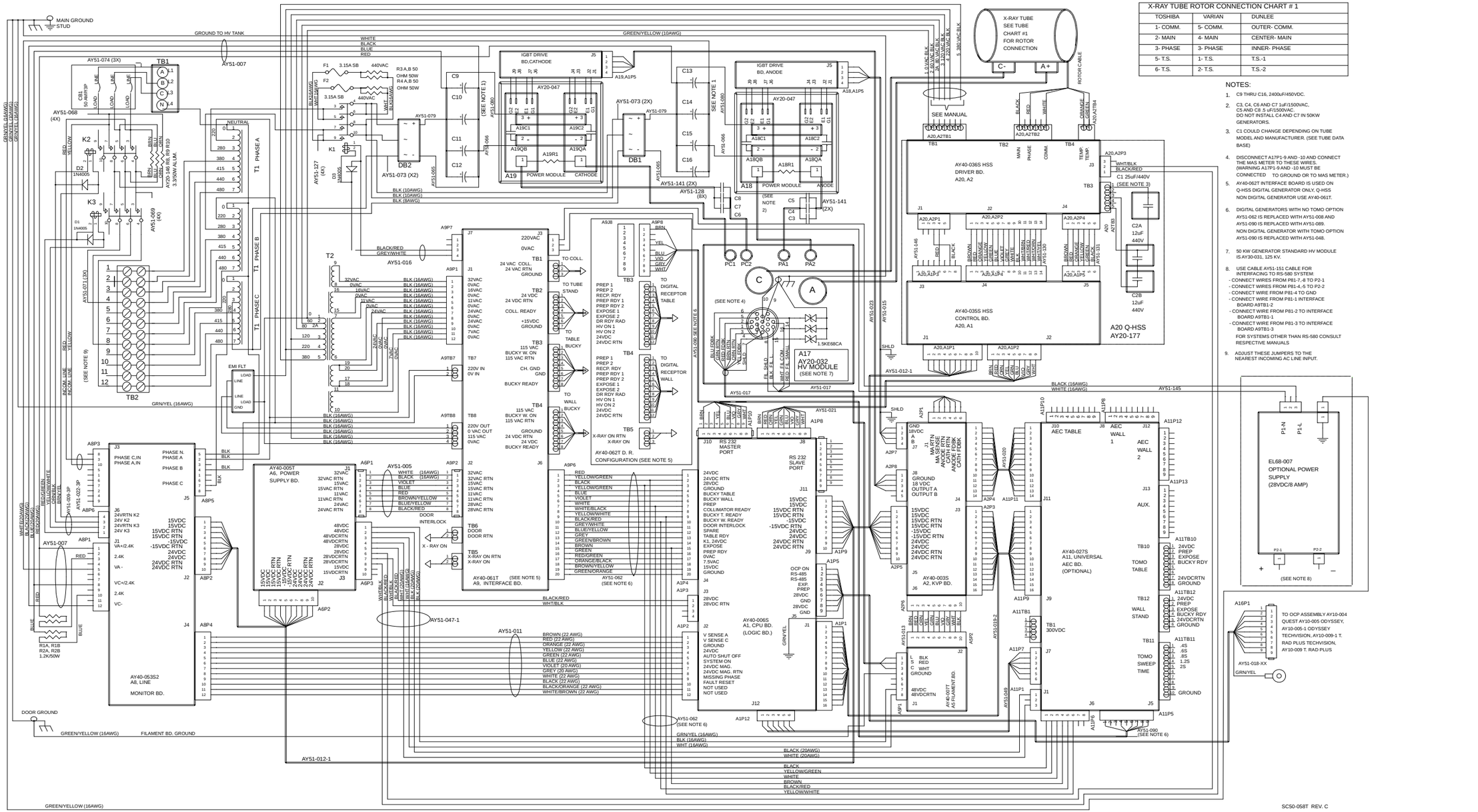

Figure 6-27. Three-Phase (65 and 80 kW with QMI High Speed Starter and Tomography Interface) X-ray Generator Interconnection Diagram

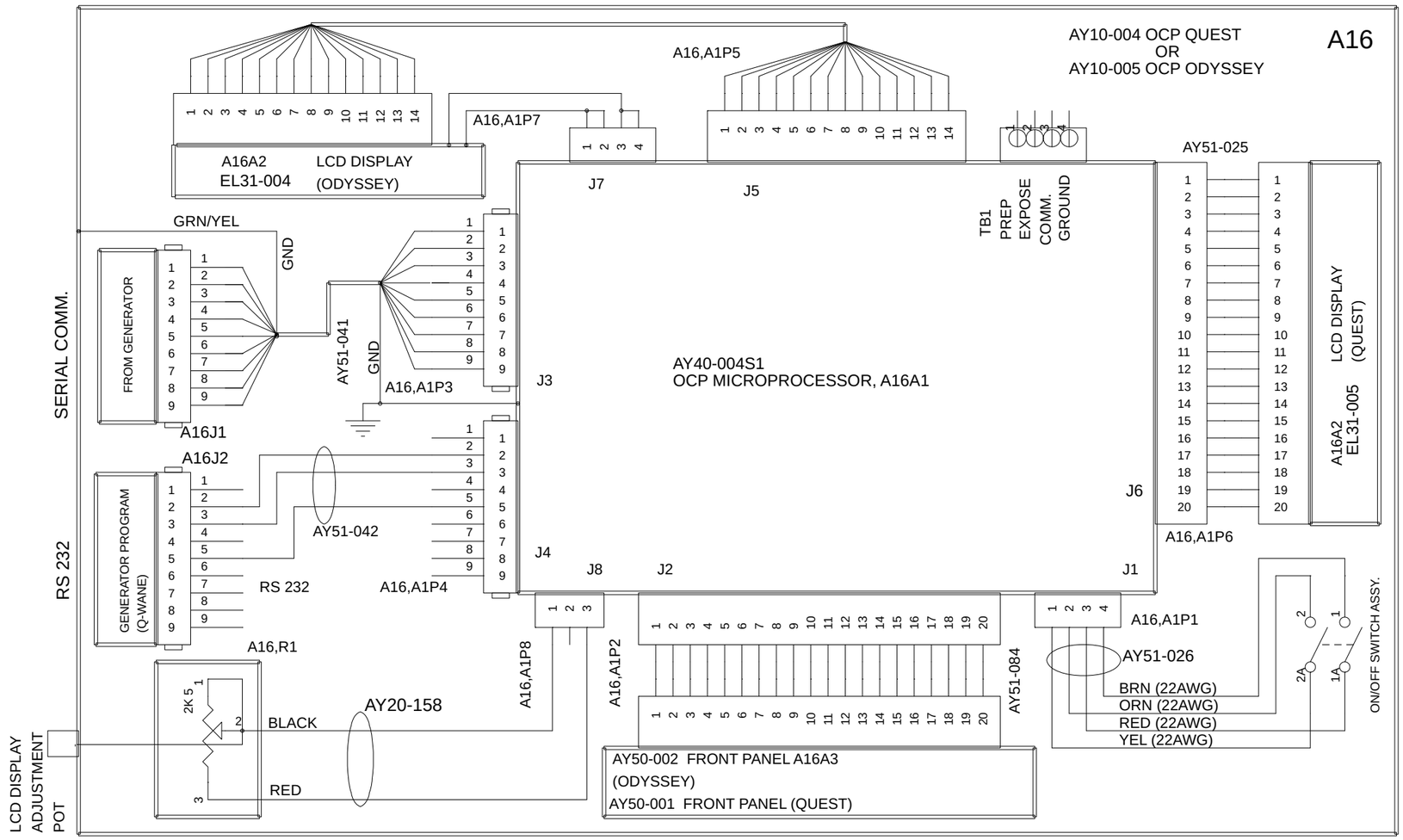

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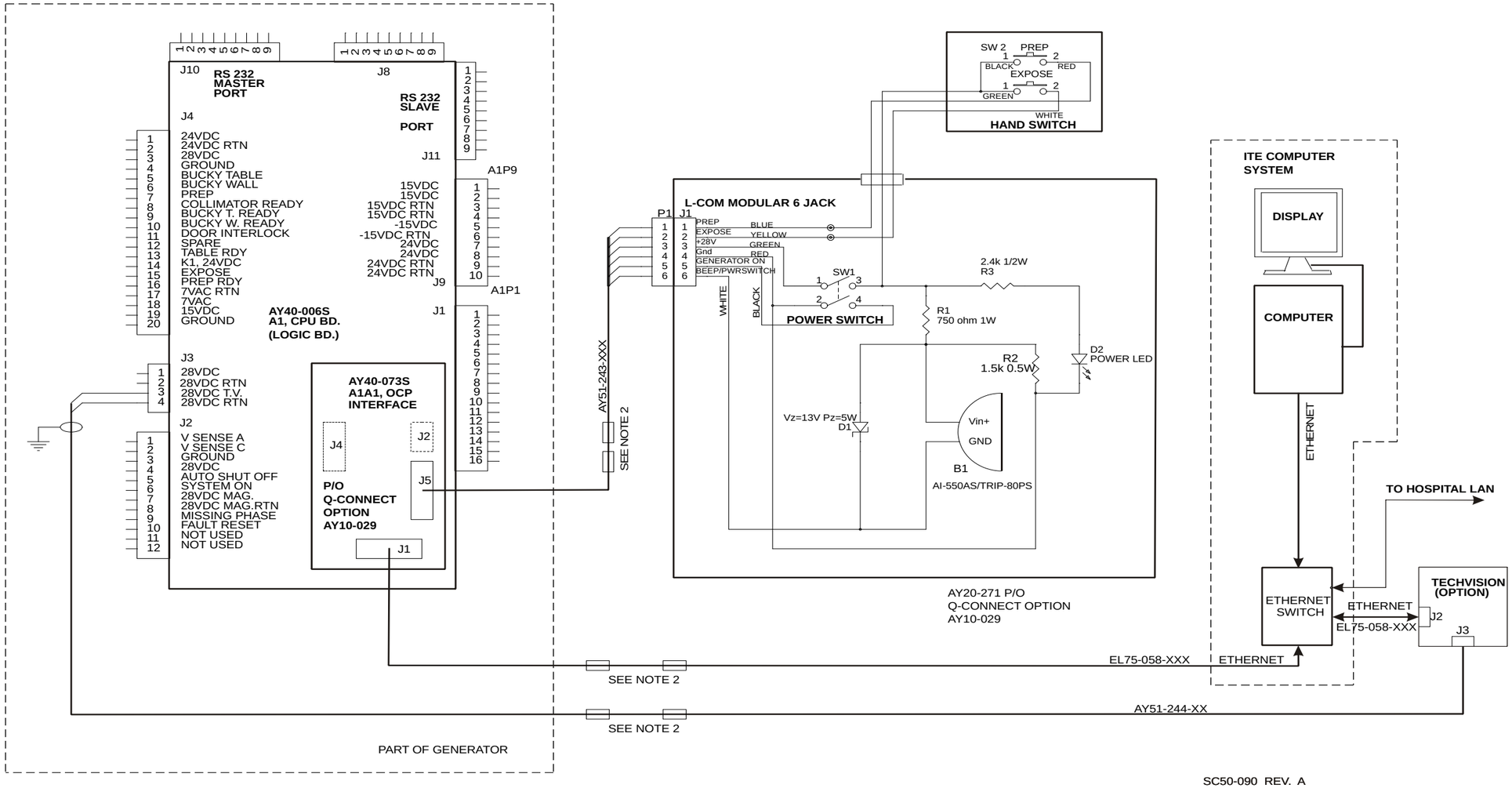
Figure 6-28. Operator Control Panel - ODYSSEY/ QUEST Wiring Diagram



NOTES:

1. THIS BLOCK DIAGRAM SHOWS ONLY CONNECTIONS OF AY40-006S FOR Q-CONNECT OPTION. THE REST OF THE CONNECTIONS OF AY40-006S ARE SHOWN IN GENERATORS BLOCK DIAGRAM.
2. EMI SUPPRESSION FERRITE CABLE SNAP ITS (1) X EL54-012 + (1) X EL54-013

Figure 6-29. Q-Connect Option System Interconnection Diagram

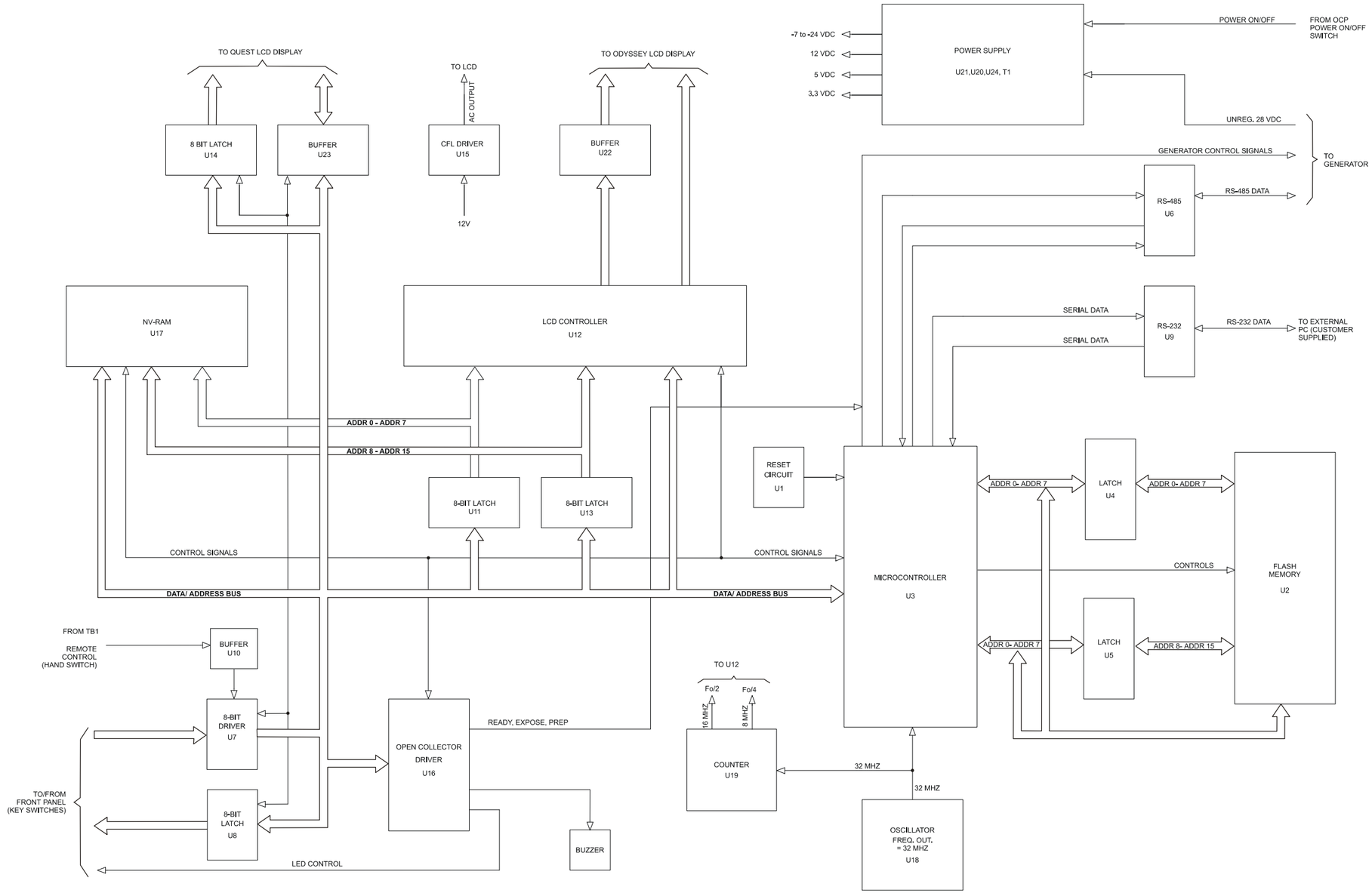


Figure 6-30. Operator Control Panel Circuit Block Diagram (Non-Q-VISION OCP)

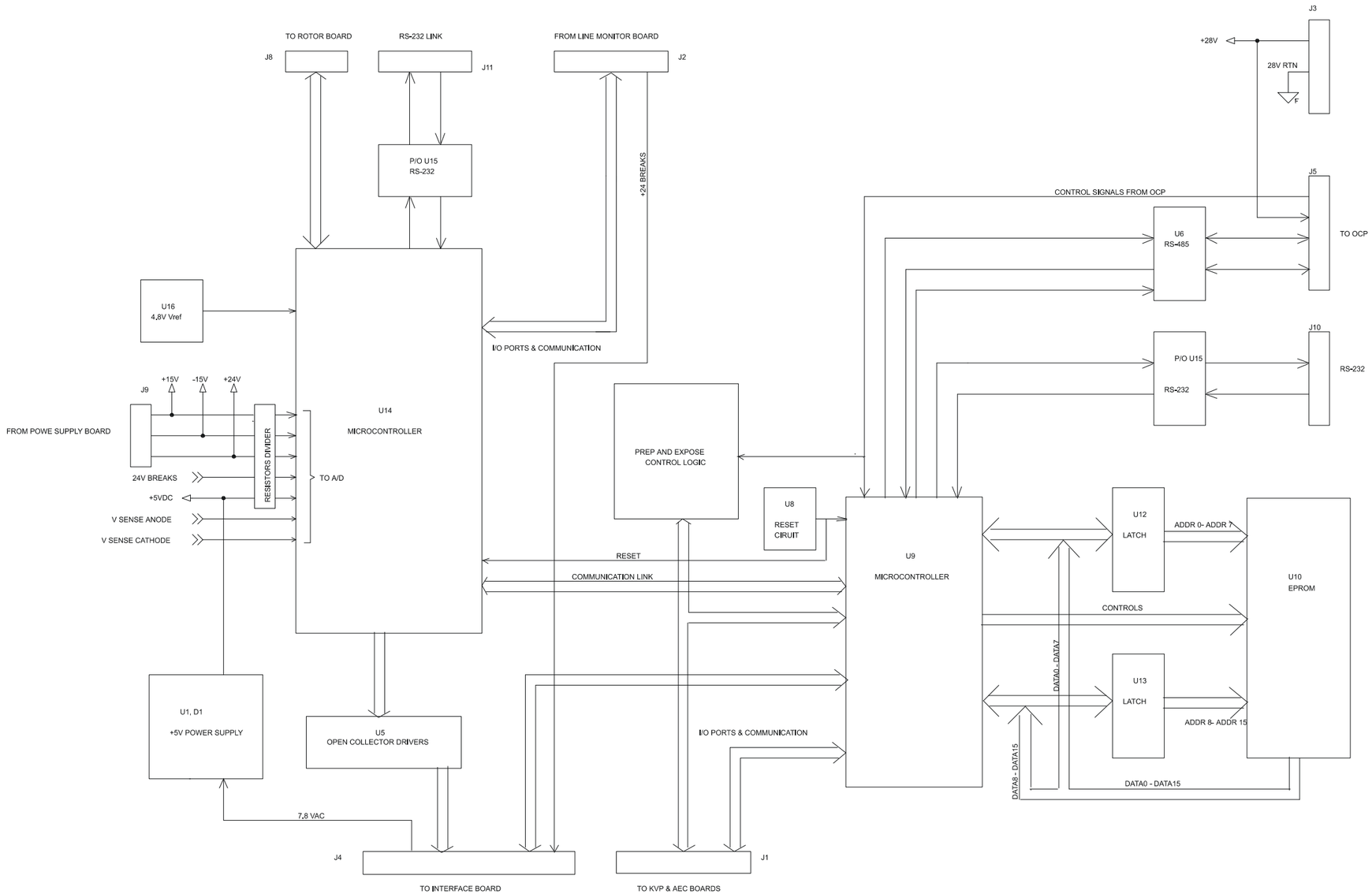


Figure 6-31. Generator Logic Circuit Block Diagram

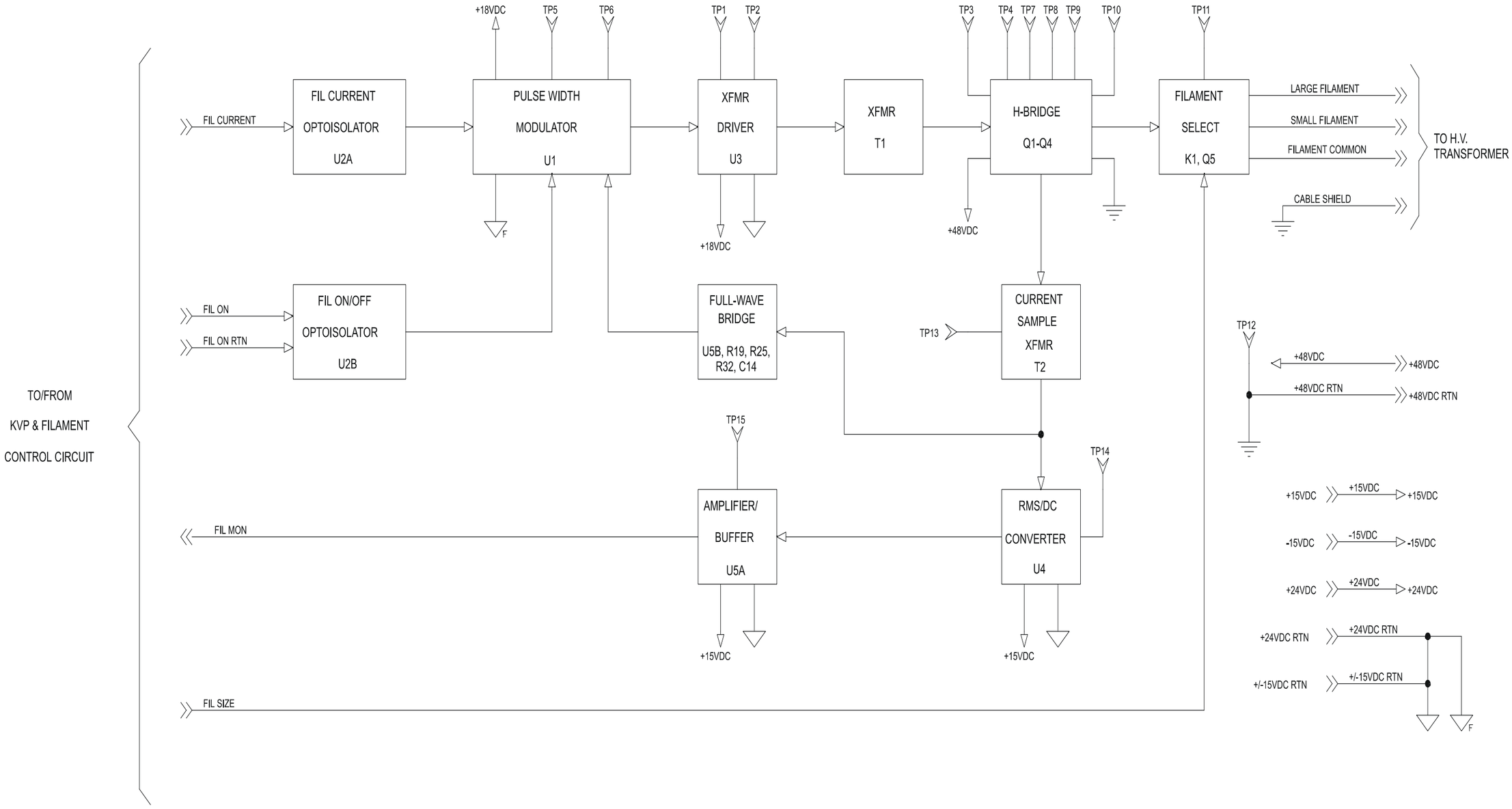


Figure 6-32. Filament Regulator Control Circuit Block Diagram

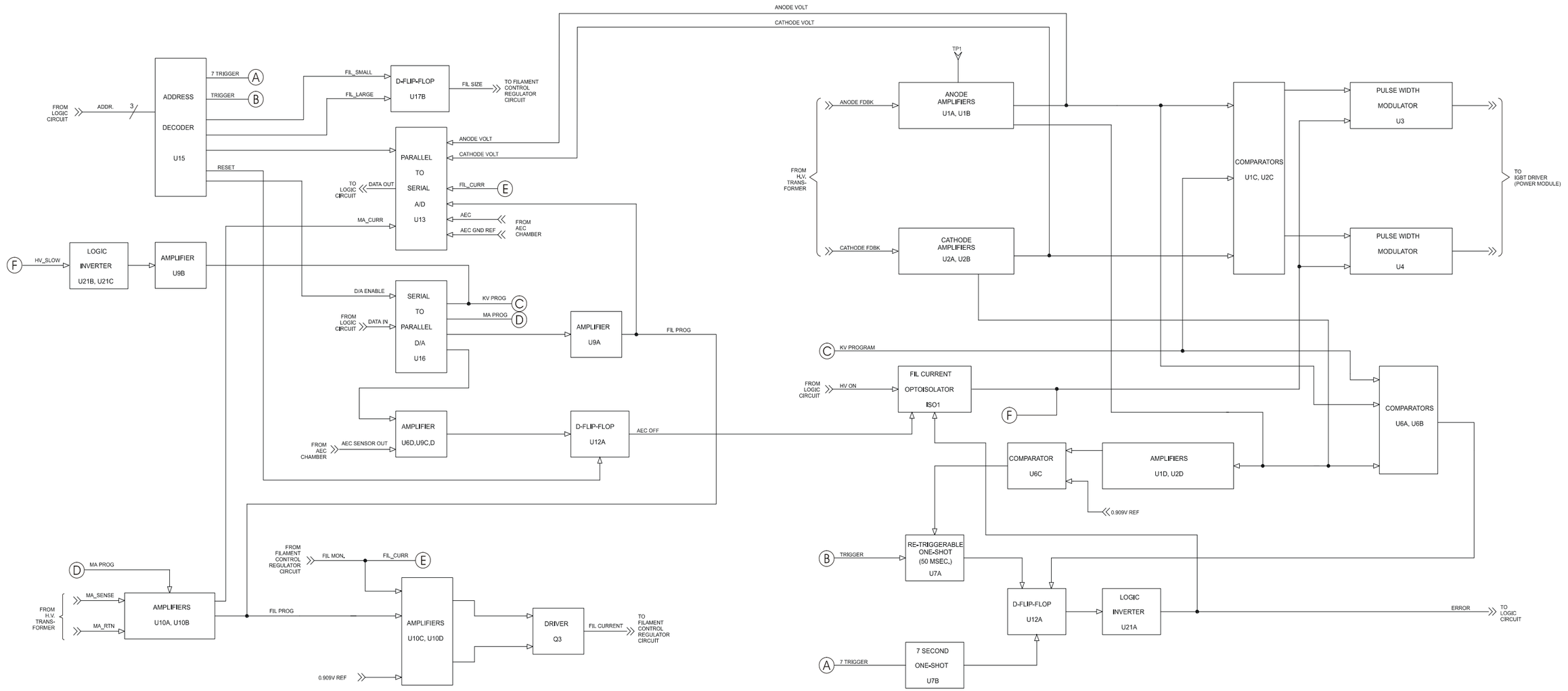
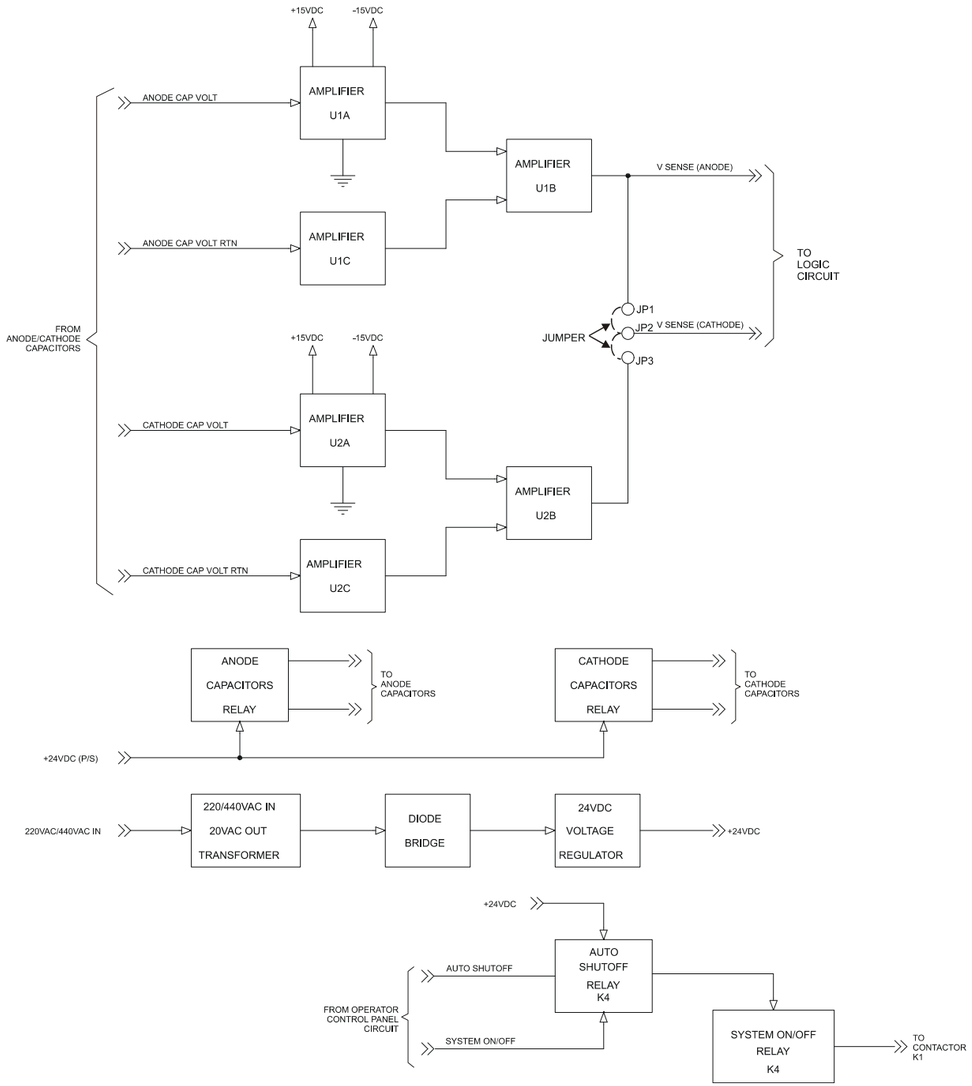


Figure 6-33. KVP & Filament Control Circuit Block Diagram



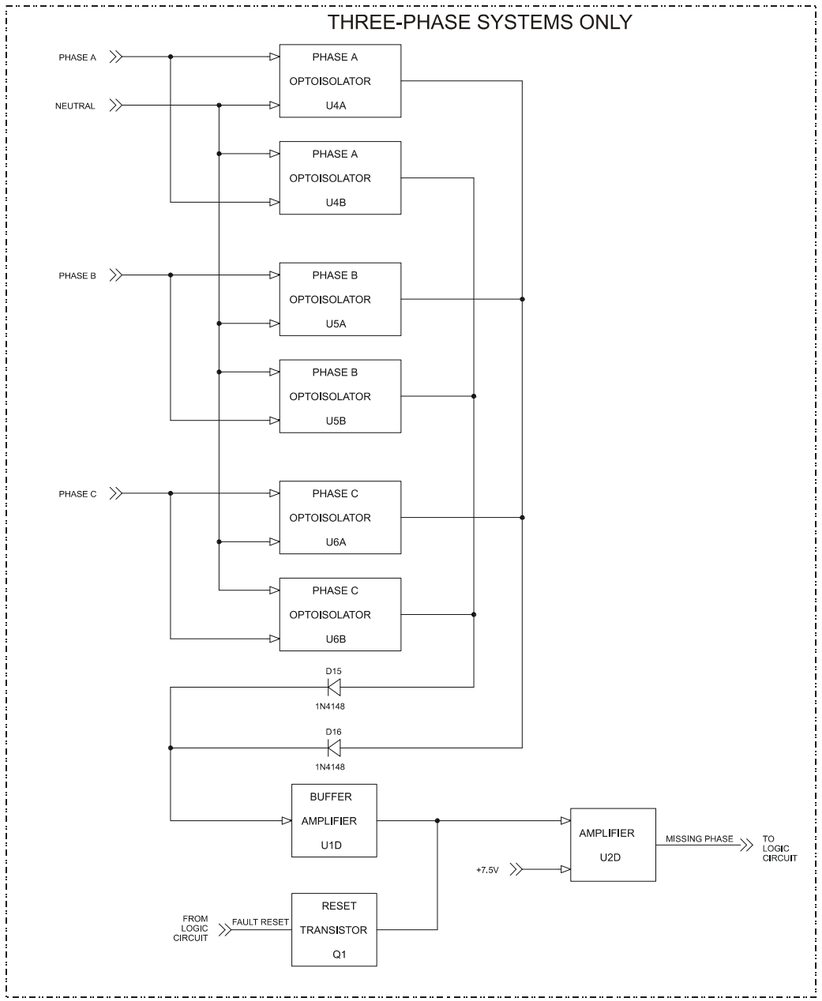


Figure 6-34. Single-Phase (Non-STORED ENERGY) and Three-Phase Line Monitor Circuit Block Diagram

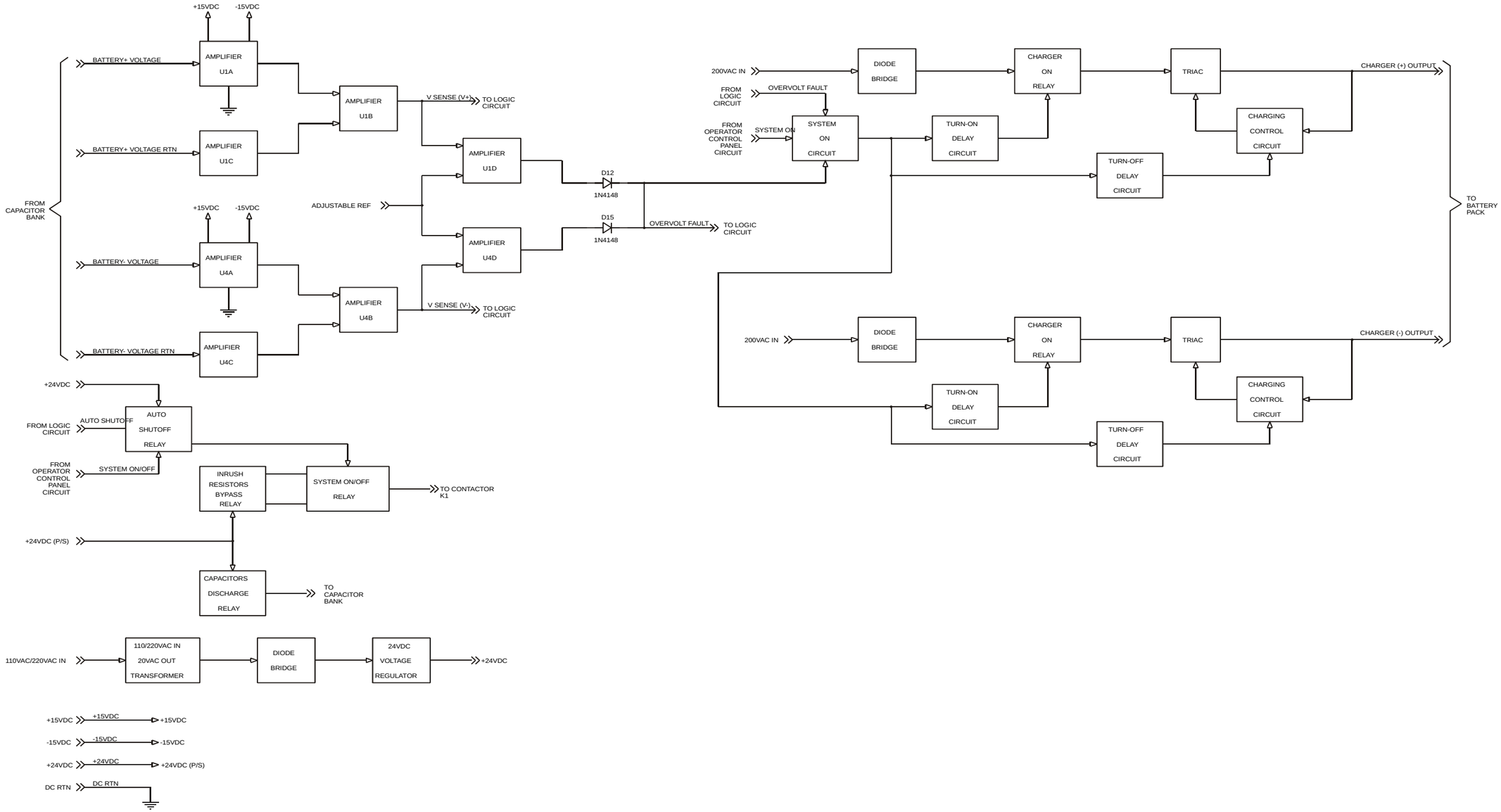


Figure 6-35. Single-Phase STORED ENERGY Line Monitor Circuit Block Diagram

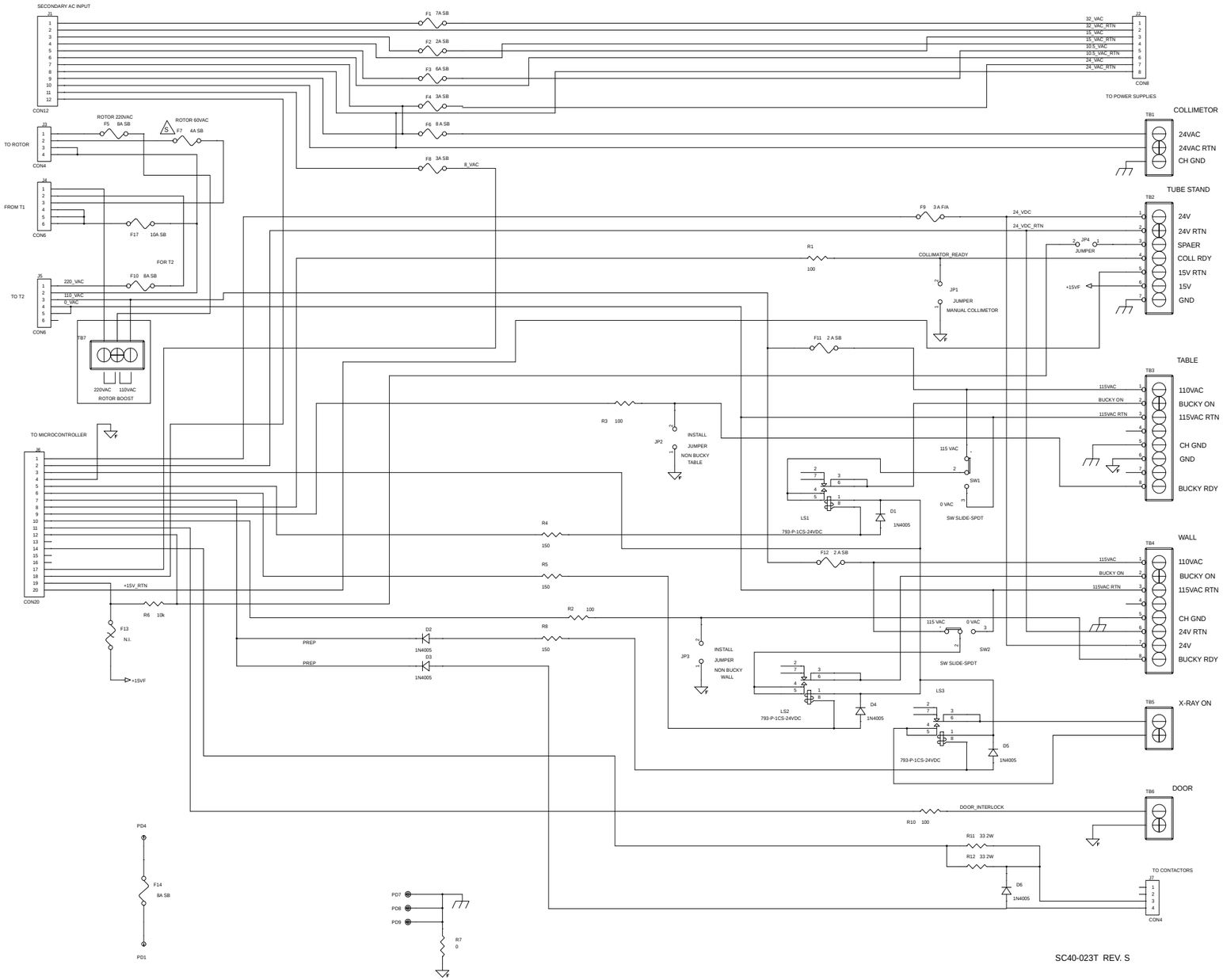


Figure 6-36. Interface Board A9 (AY40-023T/AY40-023T1) Schematic Diagram

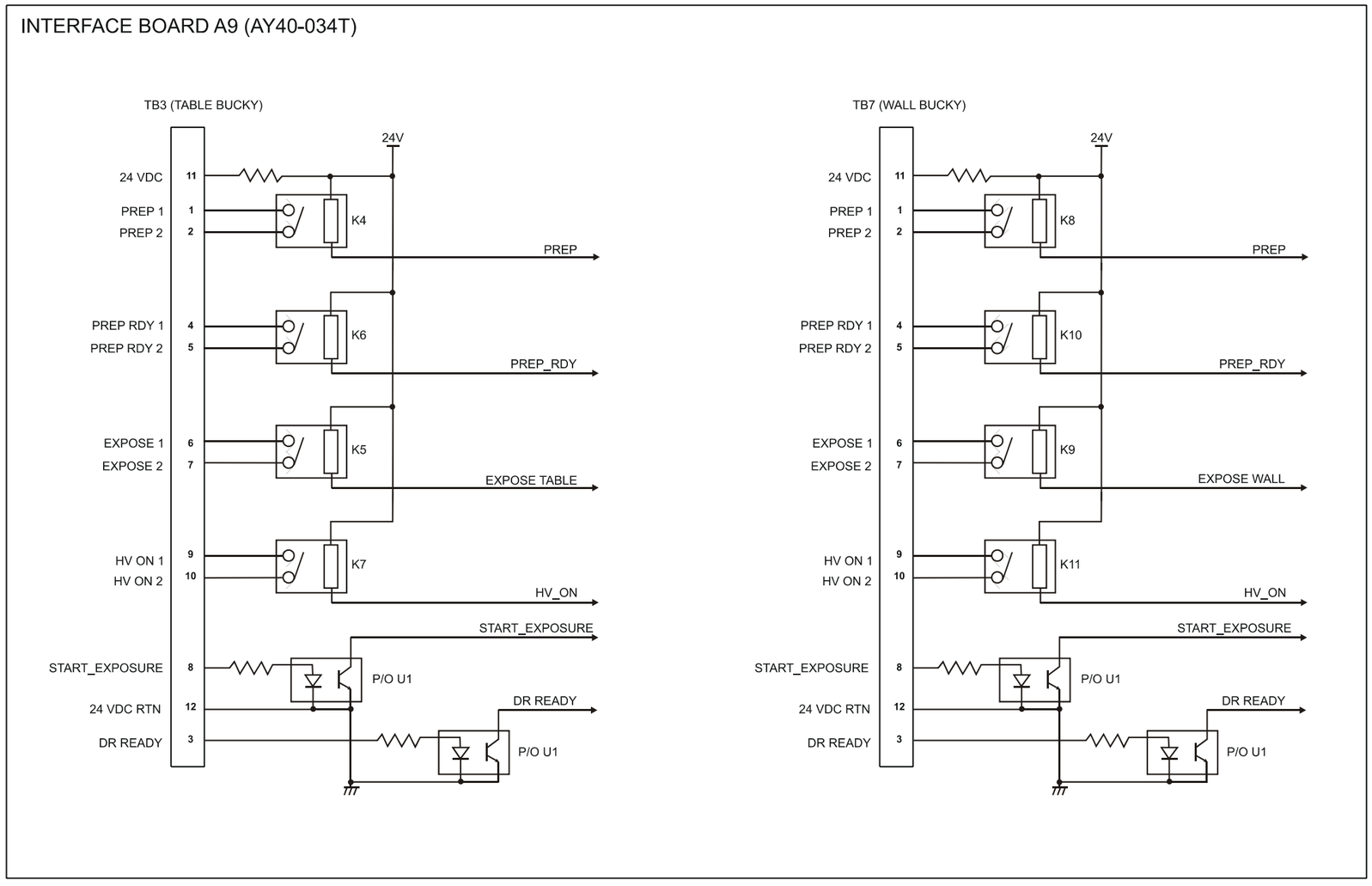


Figure 6-37. Interface Board, Digital Receptor A9 (AY40-034T) Interface Diagram

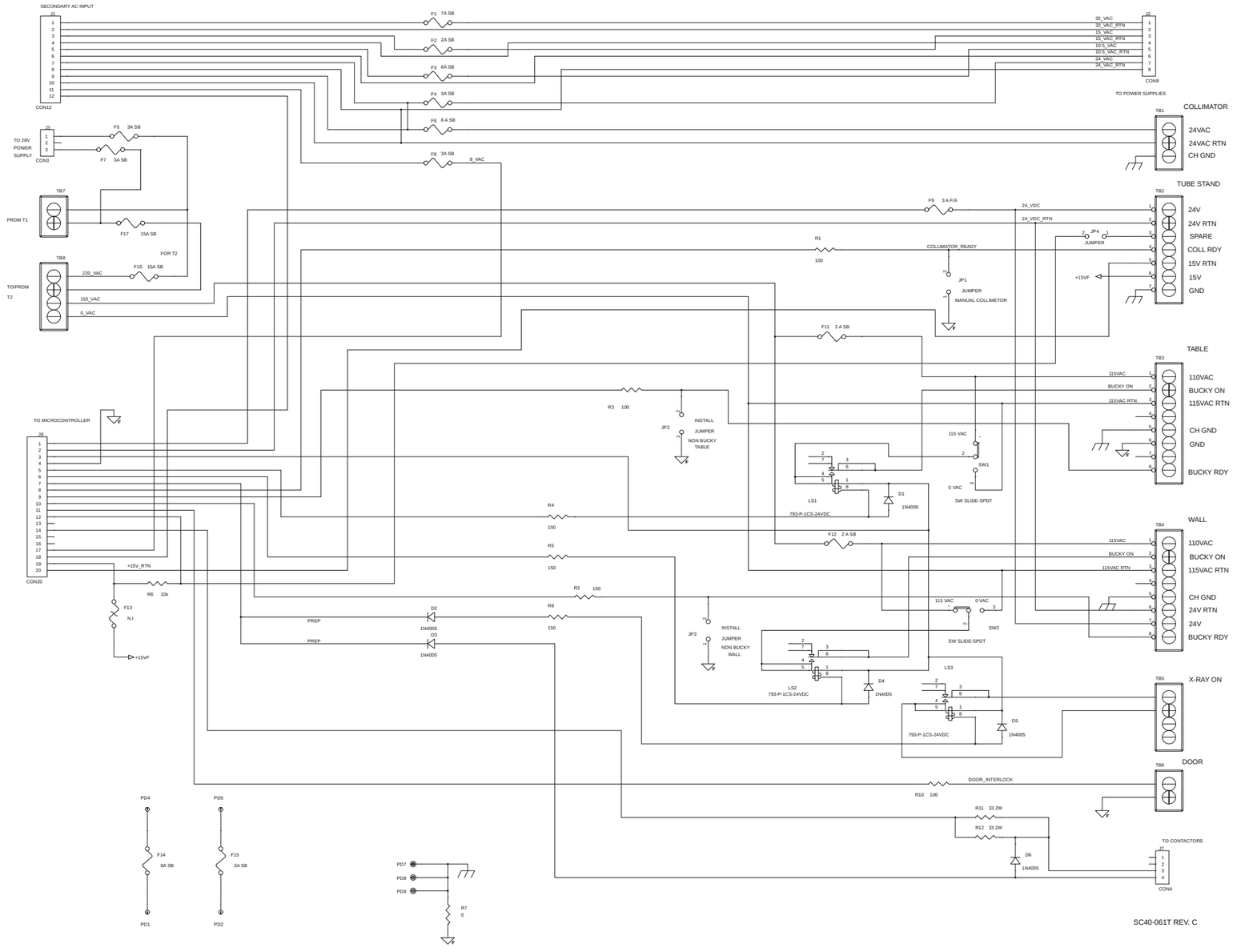


Figure 6-38. Interface Board, Digital Receptor A9 (AY40-061T) Interface Diagram

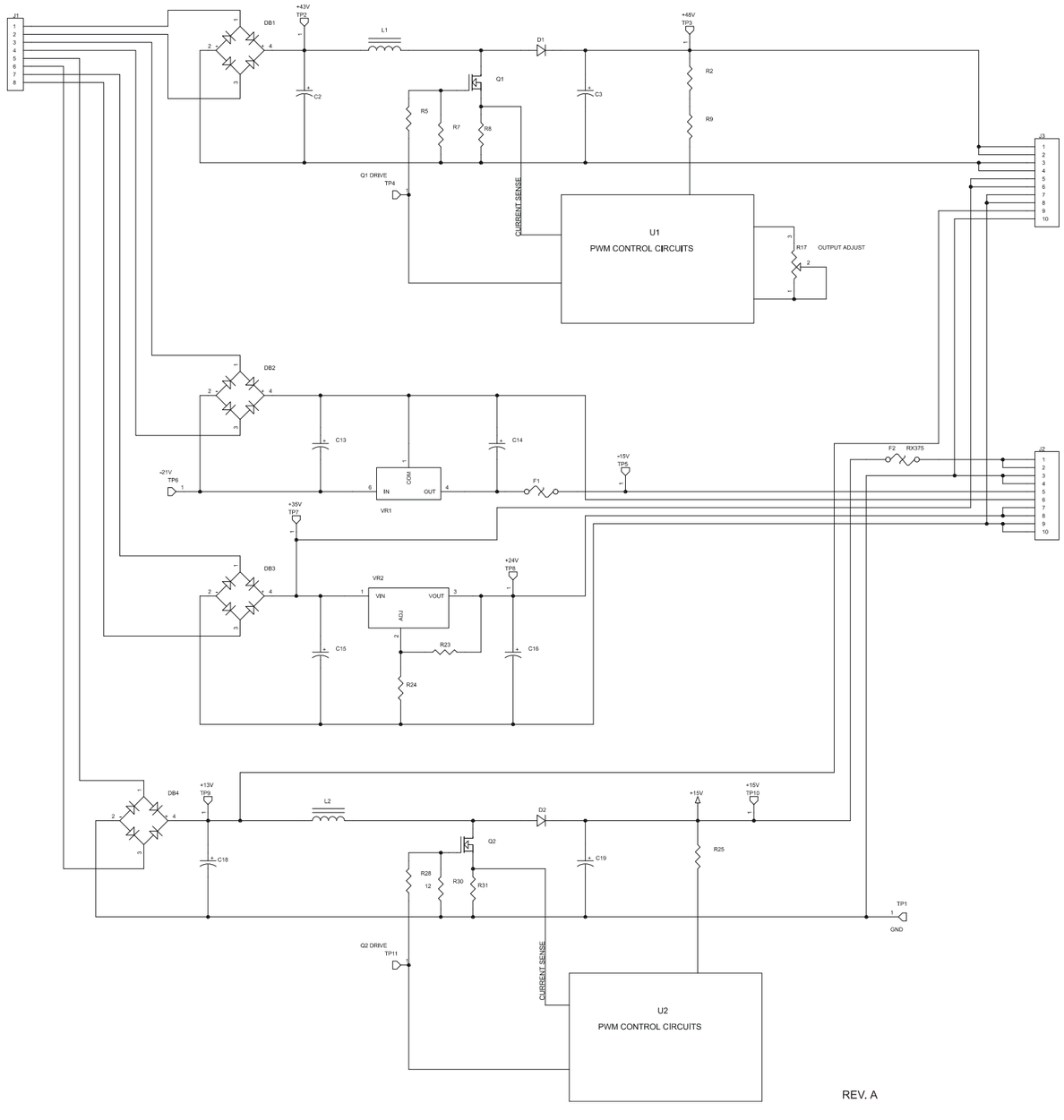


Figure 6-39. Power Supply Board A6 (AY40-005T) Schematic Diagram

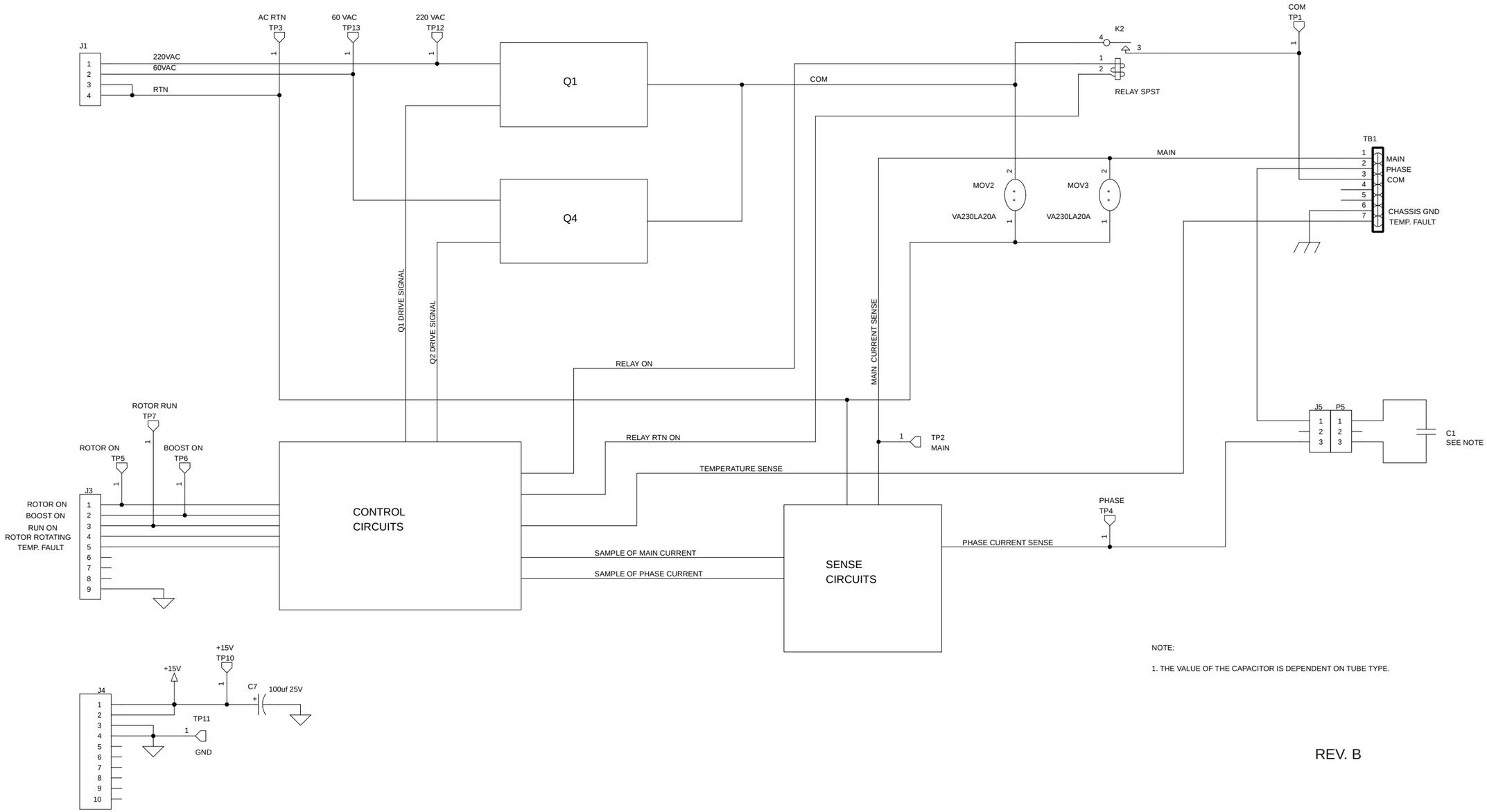


Figure 6-40. Rotor Circuit Block Diagram

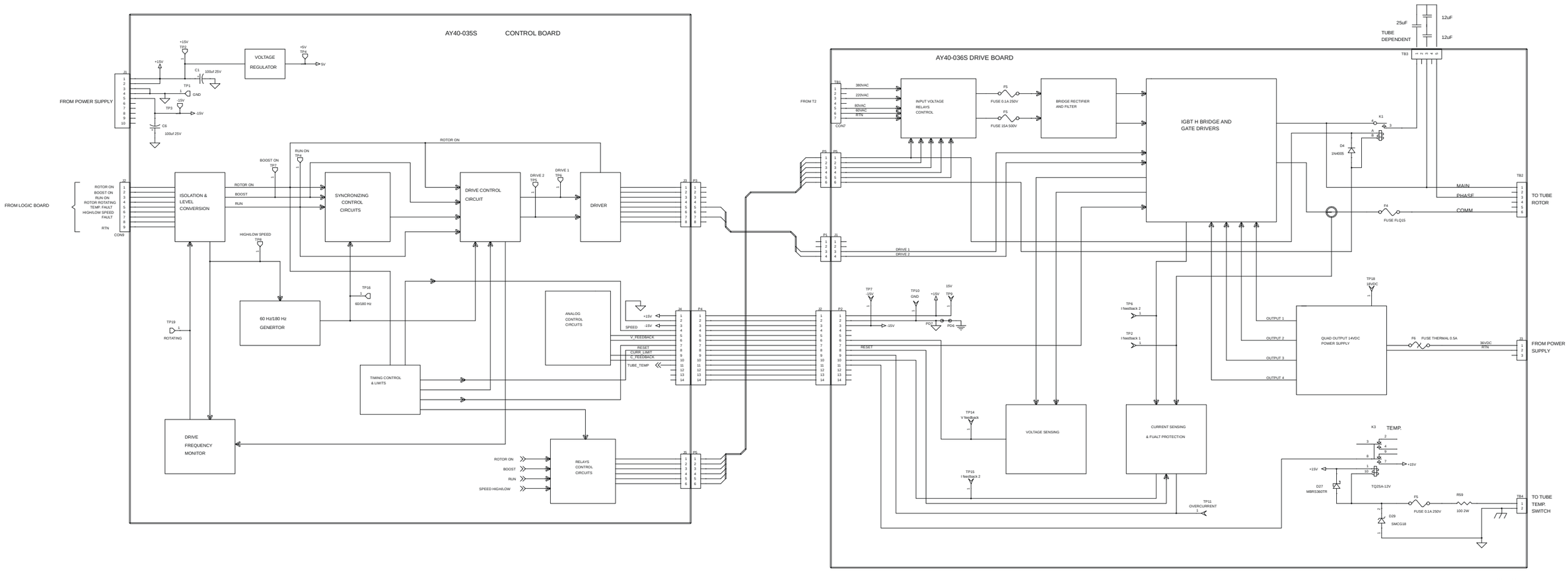
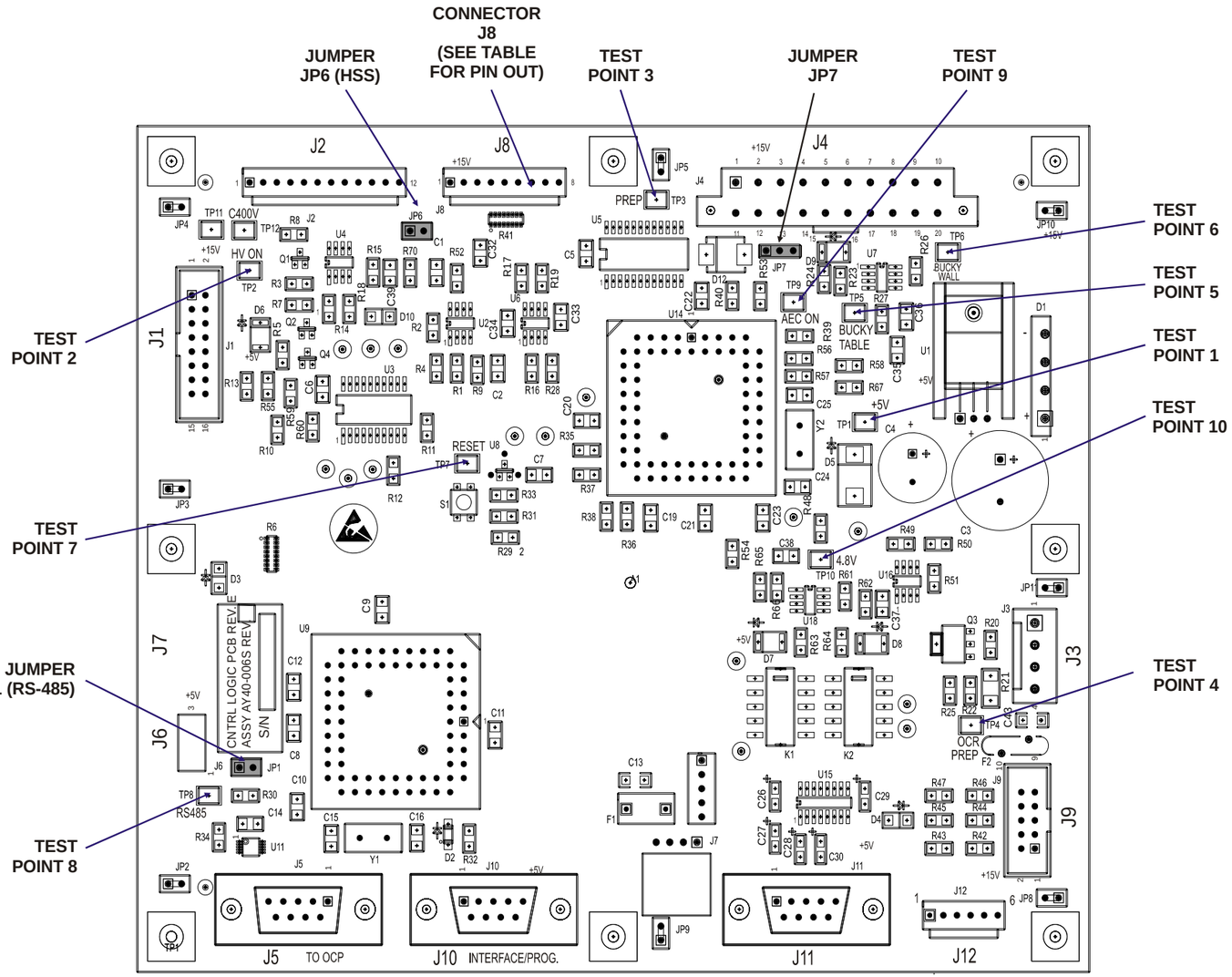


Figure 6-41. QMI High-Speed Starter Circuit Block Diagram



NOTE: " " DENOTES JUMPER LOCATION

AY40-006S REV. K

JUMPER CONFIGURATION

JP1 - ALWAYS INSTALLED

JP6 - INSTALLED ONLY ON SYSTEMS USING AID HIGH SPEED STARTER, NOT INSTALLED ON NON-HIGH SPEED STARTER SYSTEMS

JP7 - INSTALL ON PINS 2-3

TEST POINT DESCRIPTIONS

TP1 - +5 VDC

TP2 - HIGH VOLTAGE ON

TP5 - TABLE BUCKY GRID MOVING

TP6 - WALL BUCKY GRID MOVING

TP8 - OCP COMMUNICATION

TP10 - +4.8 VDC REF ON U14 (A-D)

CONNECTOR J8 PIN OUT

J8-1 HSS ON
J8-2 BOOST ON
J8-3 RUN ON
J8-4 ROTATING
J8-5 TEMP FAULT
J8-6 HIGH/LOW SPEED
J8-7 OVER CURRENT
J8-8 HSS DETECT

Figure 6-42. Logic Board A1 (AY40-006S) Test Point/ Jumper Location Diagram

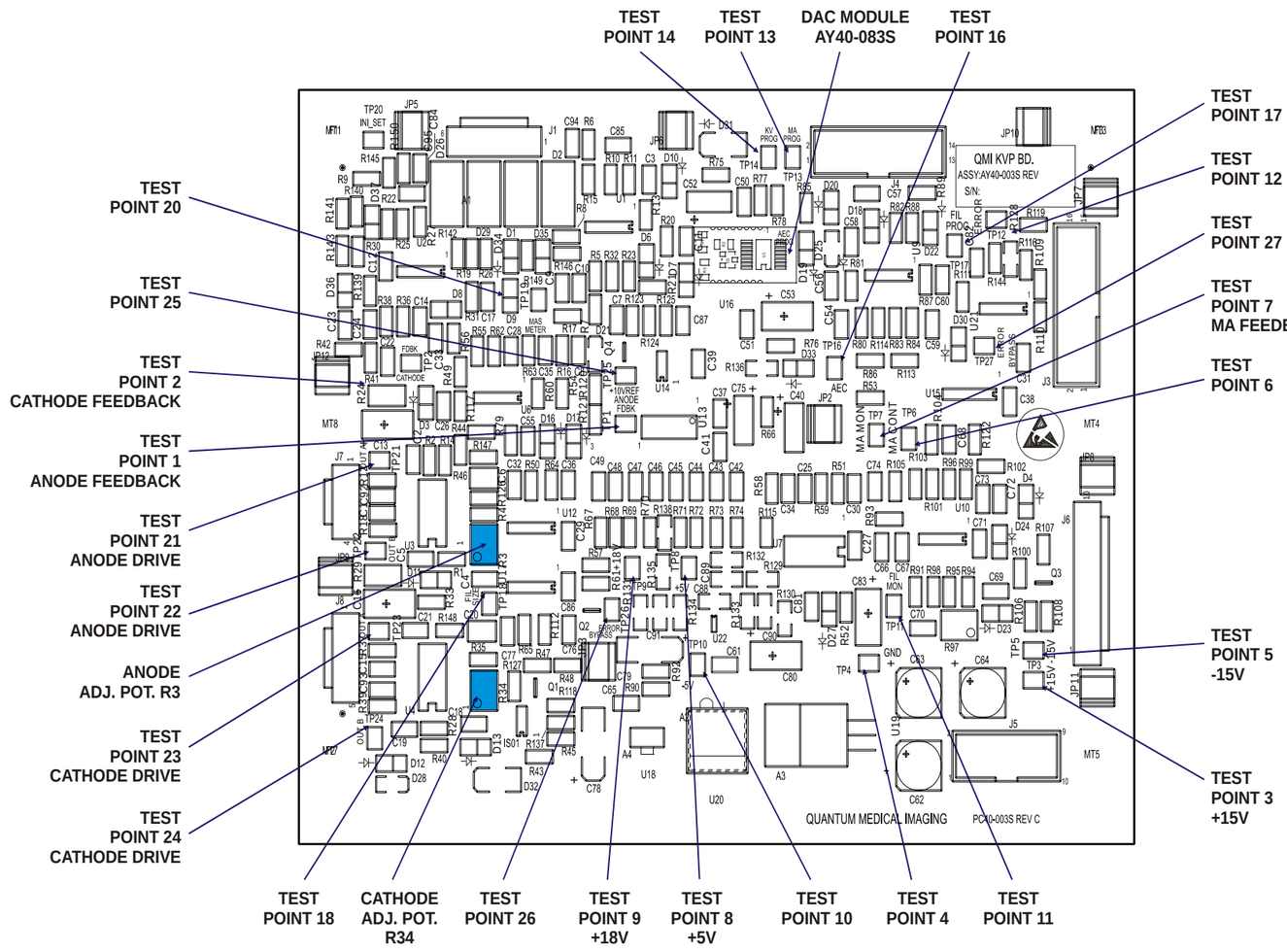


Figure 6-43. KVP Control Board A2 (AY40-003S) Test Point/Jumper Location Diagram

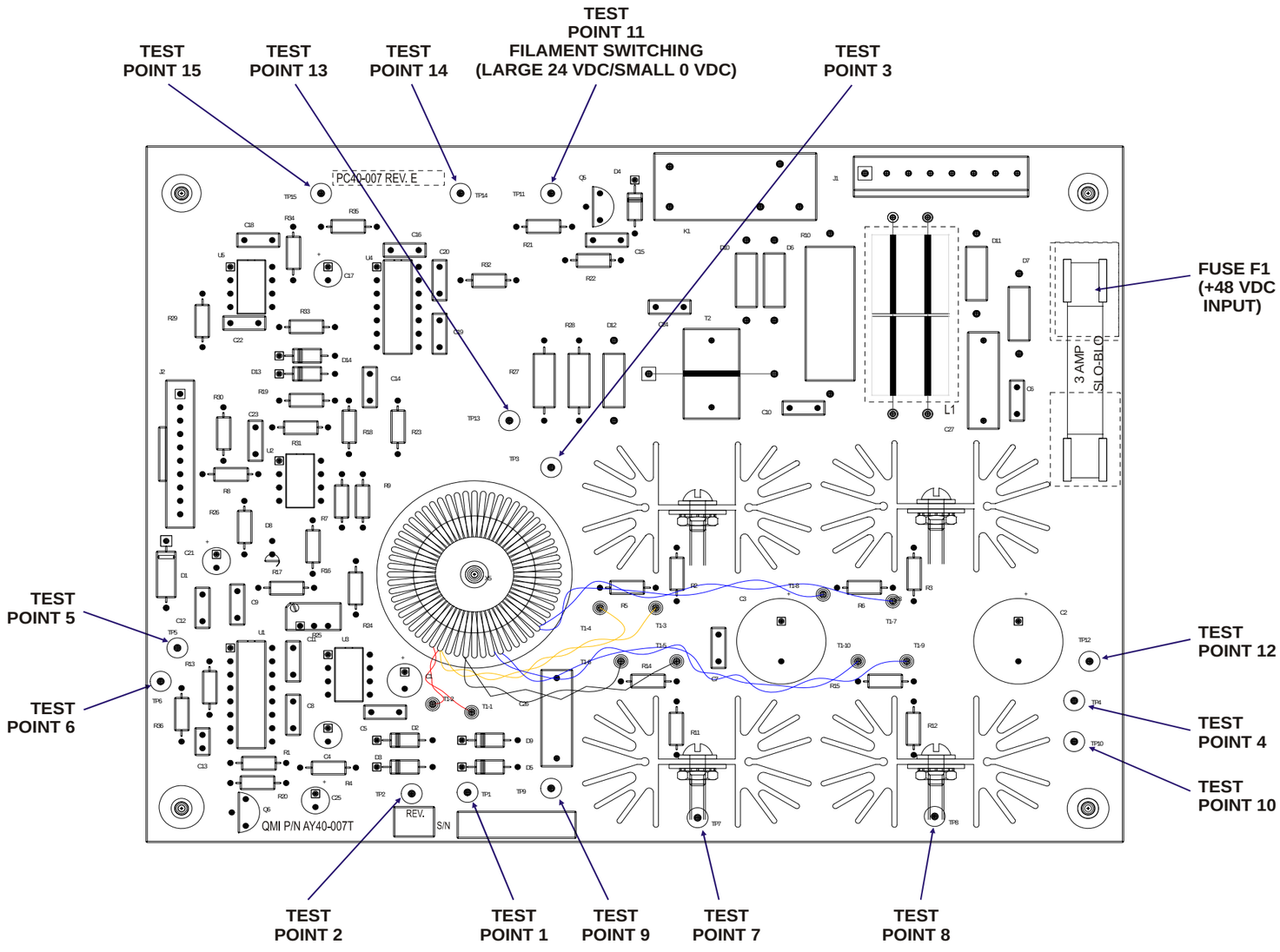


Figure 6-44. Filament Control Board A5 (AY40-007T) - Test Point/Jumper Location Diagram

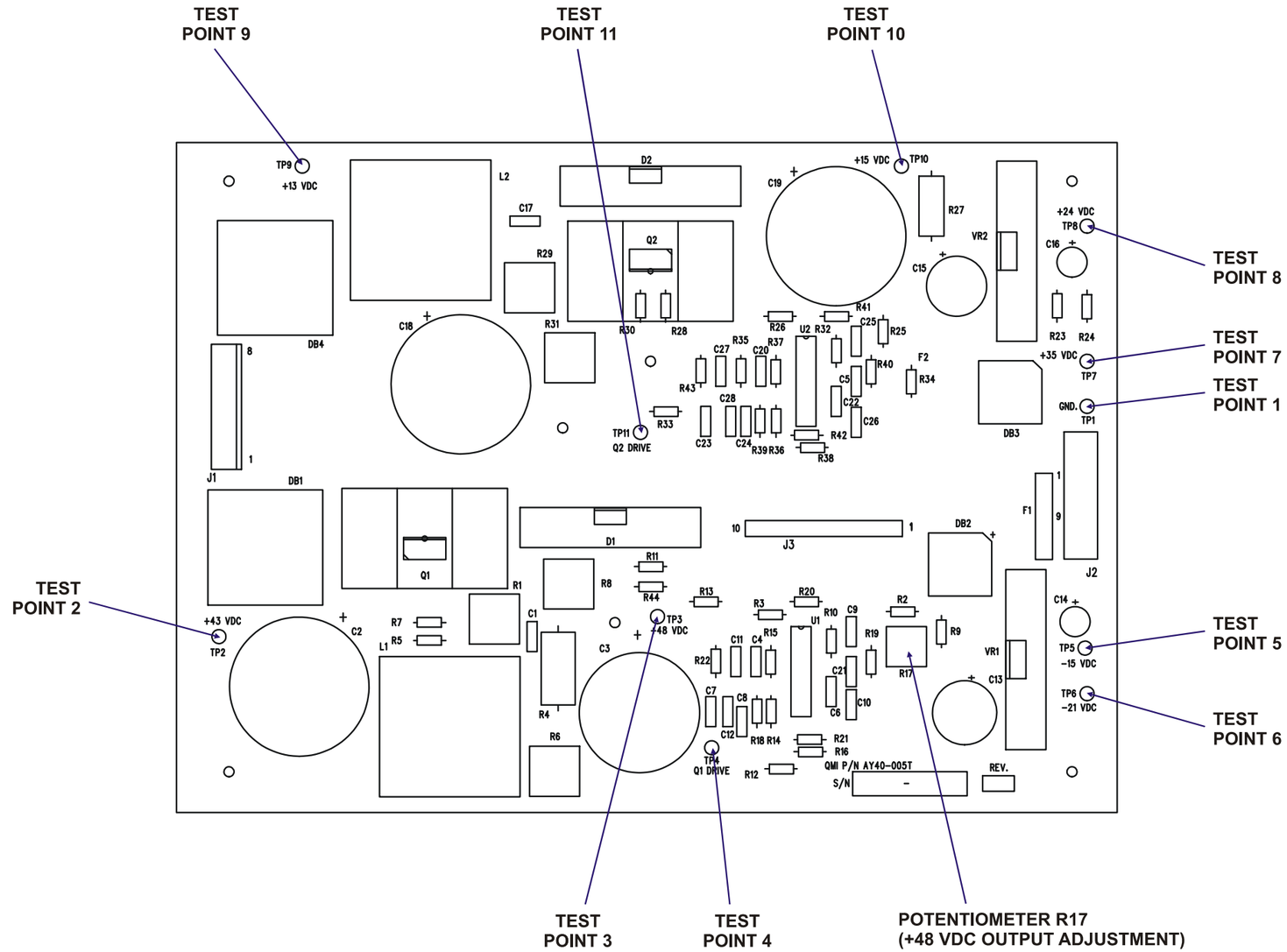
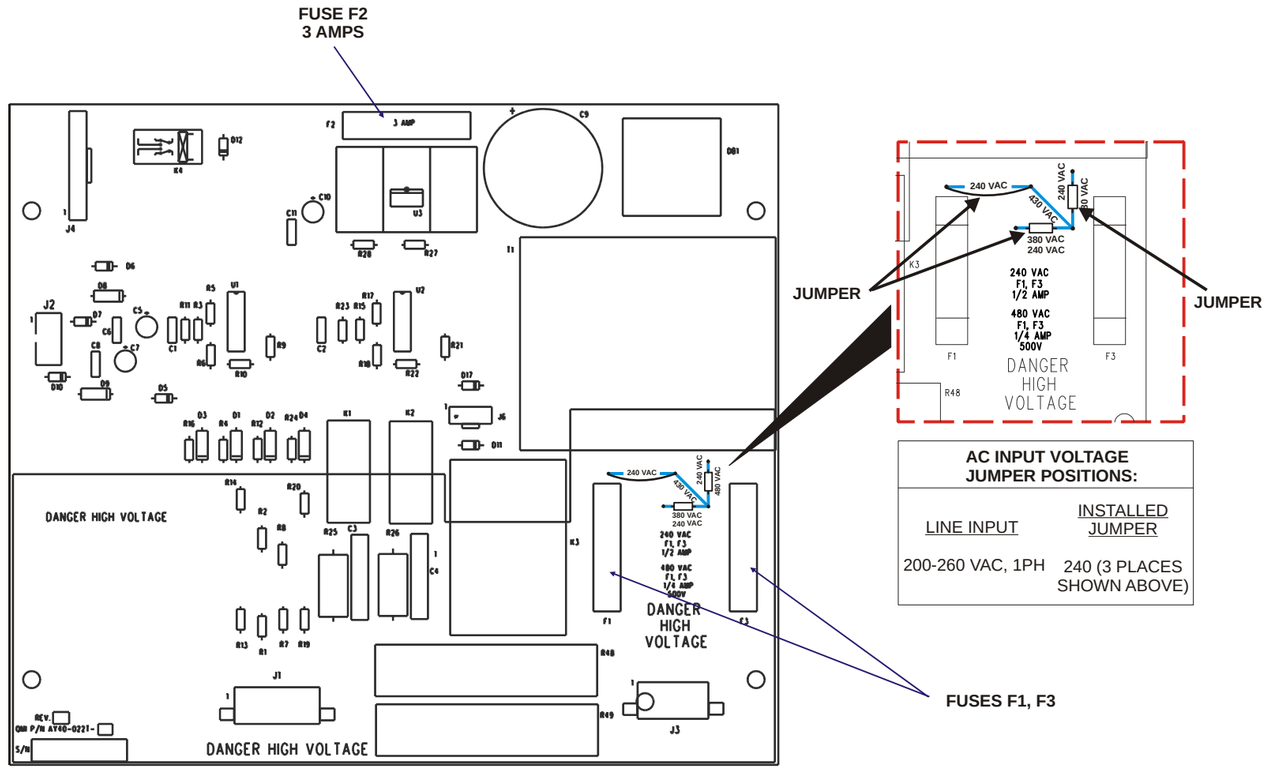


Figure 6-45. Power Supply Board A6 (AY40-005T) - Test Point/Jumper Location Diagram



AC INPUT VOLTAGE JUMPER POSITIONS:	
LINE INPUT	INSTALLED JUMPER
200-260 VAC, 1PH	240 (3 PLACES SHOWN ABOVE)

FUSE	RATING	FUNCTION
FUSE F1	1/4A (FOR 480 VAC INPUT) 1/2A (FOR 240 VAC INPUT)	AC INPUT PROTECTION
FUSE F2	3A	+30 VDC OUTPUT USED TO TURN ON GENERATOR AND FOR EXTERNAL TUBE STAND POWER SUPPLY)
FUSE F3	1/4A (FOR 480 VAC INPUT) 1/2A (FOR 240 VAC INPUT)	AC INPUT PROTECTION

Figure 6-46. Line Monitor Board A8 (AY40-022T1), Single-Phase Systems - Test Point/Jumper Location Diagram

FUSE	RATING	FUNCTION
F1, F3	4A (SLO-BLOW)	AC SUPPLY PROTECTION
F2, F4	3A (SLO-BLOW)	DC OUTPUT PROTECTION (FOR BATTERY CHARGING)
F5, F7	1A (FOR 230 VAC INPUT) 2A (FOR 115 VAC INPUT)	AC INPUT PROTECTION
F6	3A	USED TO ENERGIZE K4 AND K5 AND FOR EXTERNAL TUBE STAND POWER SUPPLY)

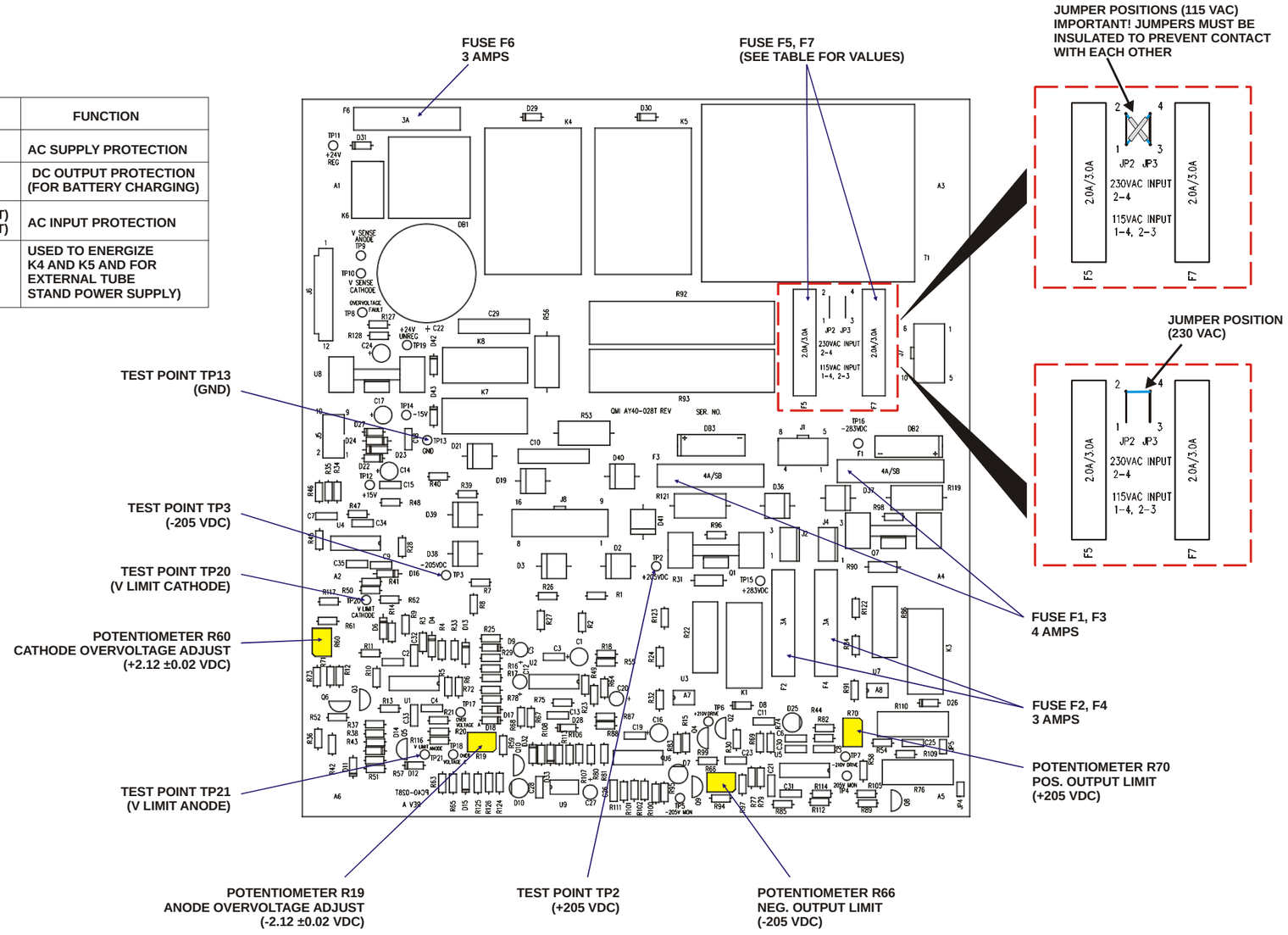
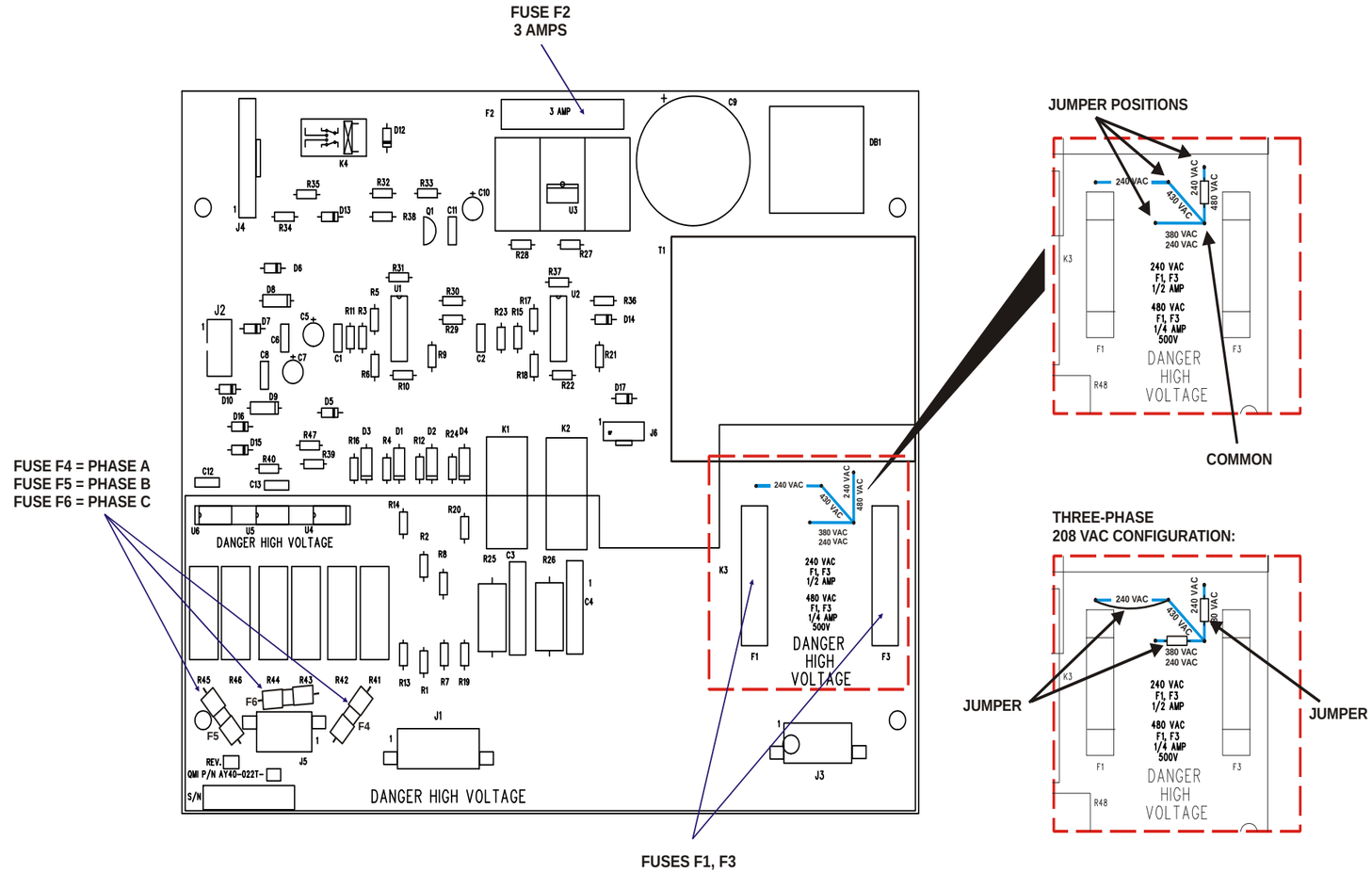
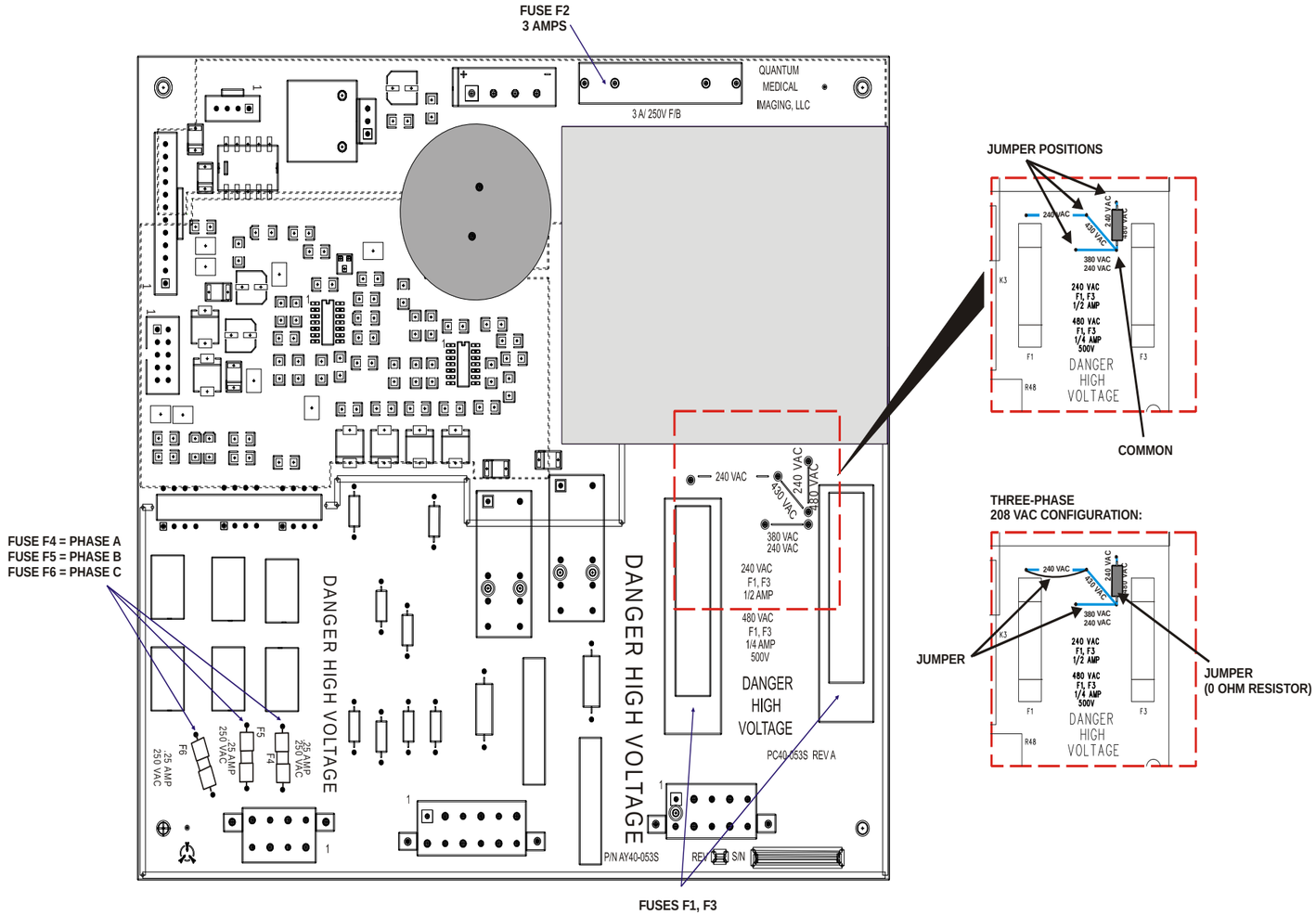


Figure 6-47. Line Monitor/Battery Charger Board A8 (AY40-028T), Stored-Energy Systems - Test Point/ Jumper Location Diagram



FUSE	RATING	FUNCTION
F1	1/4A (FOR 480 VAC INPUT) 1/2A (FOR 240 VAC INPUT)	AC INPUT PROTECTION
F2	3A	+30 VDC OUTPUT USED TO TURN ON GENERATOR AND FOR EXTERNAL TUBE STAND POWER SUPPLY)
F3	1/4A (FOR 480 VAC INPUT) 1/2A (FOR 240 VAC INPUT)	AC INPUT PROTECTION

Figure 6-48. Line Monitor Board A8 (AY40-022T2/T3), Three-Phase Systems - Test Point/Jumper Location Diagram



FUSE	RATING	FUNCTION
F1	1/4A (FOR 480 VAC INPUT) 1/2A (FOR 240 VAC INPUT)	AC INPUT PROTECTION
F2	3A	+30 VDC OUTPUT USED TO TURN ON GENERATOR AND FOR EXTERNAL TUBE STAND POWER SUPPLY)
F3	1/4A (FOR 480 VAC INPUT) 1/2A (FOR 240 VAC INPUT)	AC INPUT PROTECTION

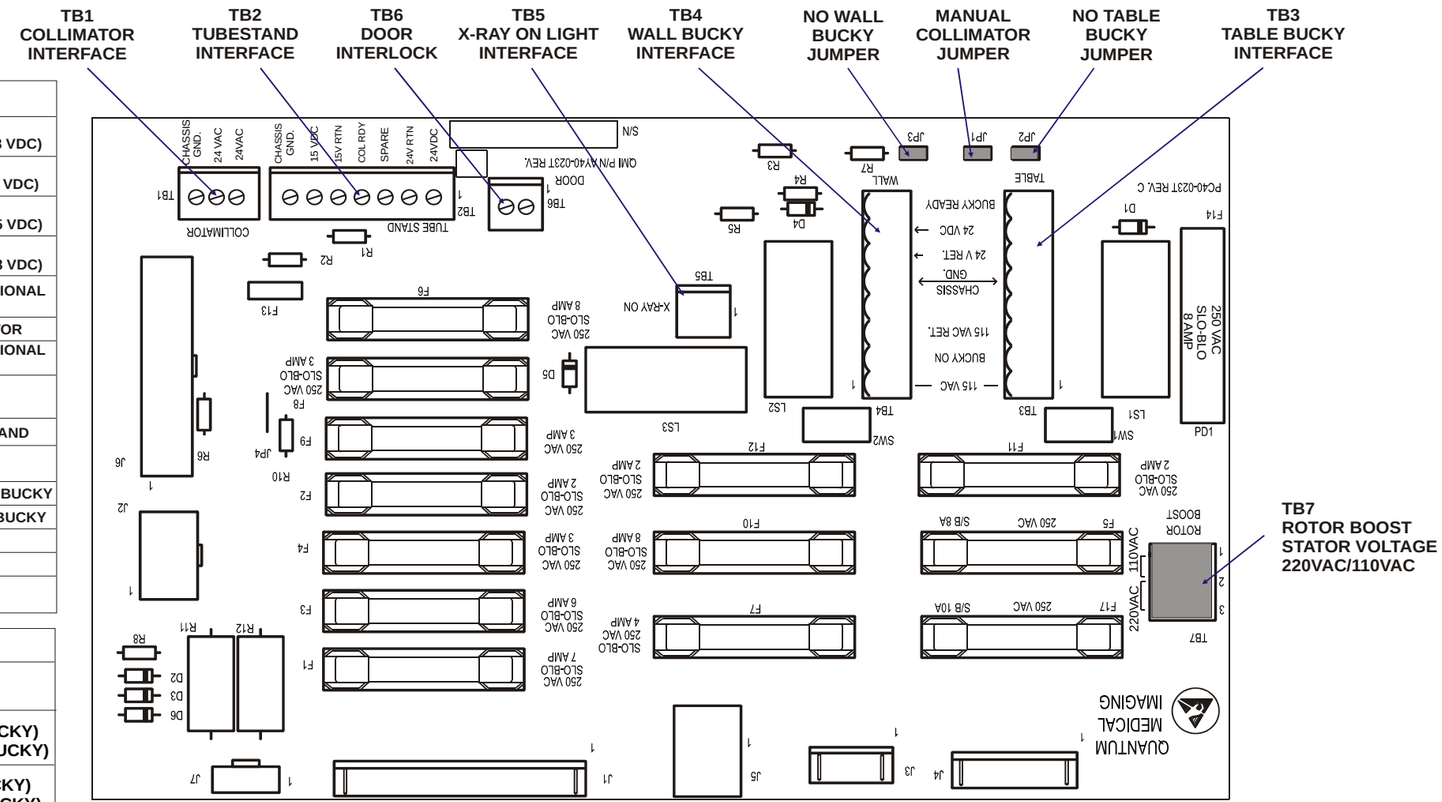
NOTE:
AY40-053S2 USED ON 380 - 480 VAC INPUT MODELS

AY40-053S3 USED ON 208 - 240 VAC INPUT MODELS

Figure 6-49. Line Monitor Board A8 (AY40-053S2/ AY40-053S3), Three-Phase QMI High-Speed Starter Systems - Test Point/Jumper Location Diagram

FUSE	RATING	FUNCTION
F1	7A, 250 VAC SLO-BLO	32 VAC TO POWER SUPPLY BD. (FOR +48 VDC)
F2	2A, 250 VAC SLO-BLO	15 VAC TO POWER SUPPLY BD. (FOR -15 VDC)
F3	6A, 250 VAC SLO-BLO	10.5 VAC TO POWER SUPPLY BD. (FOR +15 VDC)
F4	3A, 250 VAC SLO-BLO	24 VAC TO POWER SUPPLY BD. (FOR +28 VDC)
F5	8A, 250 VAC SLO-BLO (REPLACE ONLY WITH BUSSMAN MDA-8)	LINE INPUT FOR OPTIONAL POWER SUPPLY
F6	8A, 250 VAC SLO-BLO	24 VAC TO COLLIMATOR
F7	4A, 250 VAC SLO-BLO (REPLACE ONLY WITH BUSSMAN MDA-4)	LINE INPUT FOR OPTIONAL POWER SUPPLY
F8	3A, 250 VAC SLO-BLO	8 VAC TO LOGIC BD. (FOR +5 VDC)
F9	3A, 250 VAC FAST-ACT	+24 VDC TO TUBE STAND
F10	8A, 250 VAC SLO-BLO (REPLACE ONLY WITH BUSSMAN MDA-8)	LINE INPUT FOR TRANSFORMER T2
F11	2A, 250 VAC SLO-BLO	120 VAC FOR TABLE BUCKY
F12	2A, 250 VAC SLO-BLO	120 VAC FOR WALL BUCKY
F14	15A, 250 VAC SLO-BLO	SPARE
F15	3A, 250 VAC SLO-BLO	SPARE
F17	10A, 250 VAC SLO-BLO (REPLACE ONLY WITH BUSSMAN MDA-10)	LINE INPUT FOR TRANSFORMER T2

JUMPER DESIG.	FUNCTION	SETTING
JP1	MAN./AUTO COLL.	INSTALLED (MANUAL) NOT INSTALLED (AUTO)
JP2	TABLE BUCKY	INSTALLED (NO TABLE BUCKY) NOT INSTALLED (TABLE BUCKY)
JP3	WALL BUCKY	INSTALLED (NO WALL BUCKY) NOT INSTALLED (WALL BUCKY)
TB7	ROTOR BOOST STATOR VOLTAGE	INSTALL ON 1 & 2 (TOSHIBA E7242X, E7813X, E7252X, E7239X TUBES) INSTALL ON 2 & 3 (ALL OTHER TUBE TYPES)

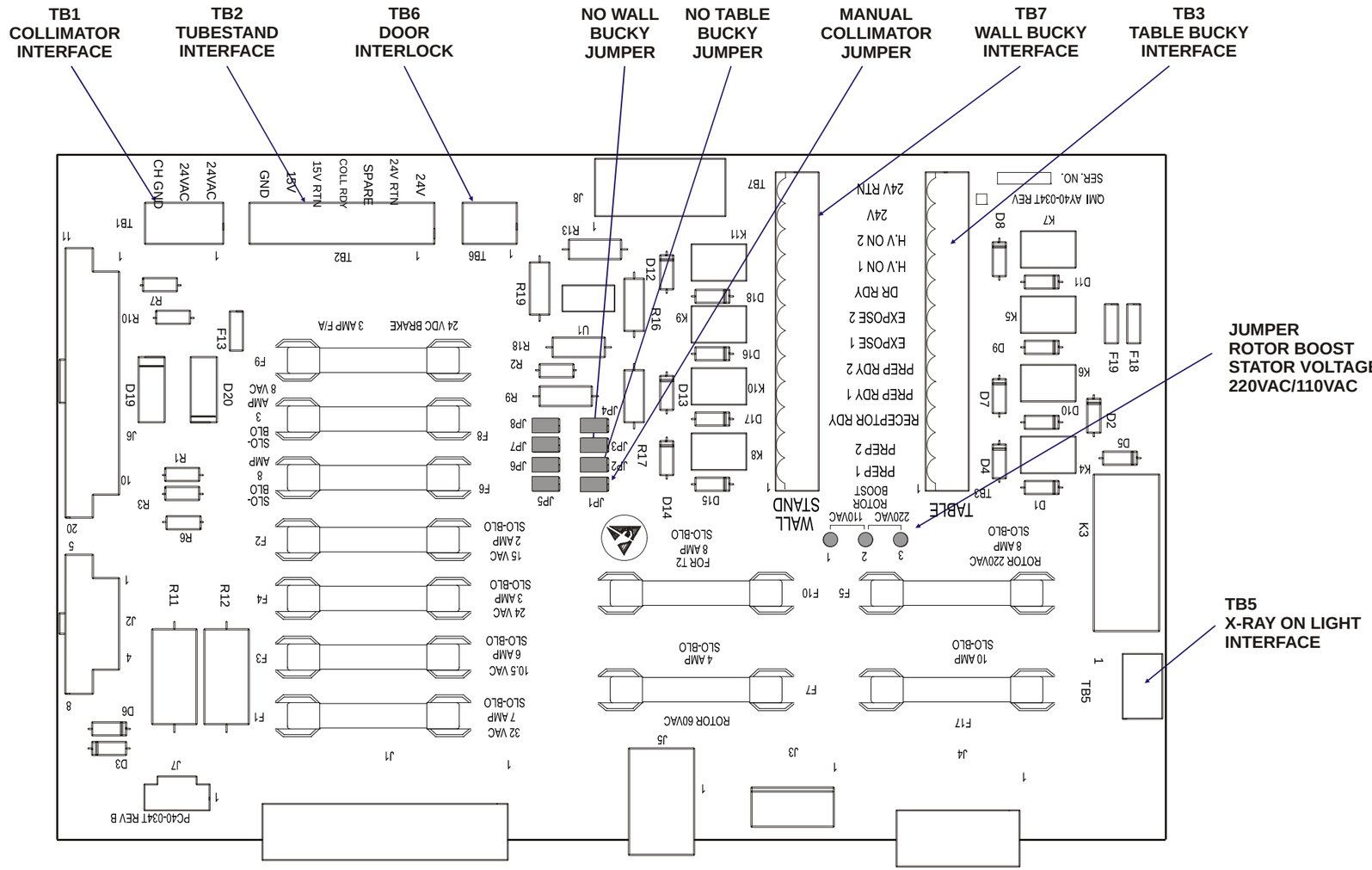


NOTE: " " DENOTES JUMPER LOCATION

Figure 6-50. Interface Board (No HSS Non-Digital) A9 (AY40-023T) - Terminal Block/Jumper Location Diagram

FUSE	RATING	FUNCTION
F1	7A, 250 VAC SLO-BLO	32 VAC TO POWER SUPPLY BD. (FOR +48 VDC)
F2	2A, 250 VAC SLO-BLO	15 VAC TO POWER SUPPLY BD. (FOR -15 VDC)
F3	6A, 250 VAC SLO-BLO	10.5 VAC TO POWER SUPPLY BD. (FOR +15 VDC)
F4	3A, 250 VAC SLO-BLO	24 VAC TO POWER SUPPLY BD. (FOR +28 VDC)
F5	8A, 250 VAC SLO-BLO (REPLACE ONLY WITH BUSSMAN MDA-8)	220 VAC TO ROTOR DRIVE BD.
F6	8A, 250 VAC SLO-BLO	24 VAC TO COLLIMATOR
F7	3A, 250 VAC SLO-BLO (REPLACE ONLY WITH BUSSMAN MDA-3)	60 VAC TO ROTOR DRIVE BD.
F8	3A, 250 VAC SLO-BLO	8 VAC TO LOGIC BD. (FOR +5 VDC)
F9	3A, 250 VAC FAST-ACT	+24 VDC TO TUBE STAND
F10	8A, 250 VAC SLO-BLO (REPLACE ONLY WITH BUSSMAN MDA-8)	220 VAC SUPPLY FOR TRANSFORMER T2
F17	10A, 250 VAC SLO-BLO (REPLACE ONLY WITH BUSSMAN MDA-10)	0 VAC SUPPLY FOR TRANSFORMER T2

JUMPER DESIG.	FUNCTION	SETTING
JP1	MAN./AUTO COLL.	INSTALLED (MANUAL) NOT INSTALLED (AUTO)
JP2	TABLE BUCKY	INSTALLED (NO TABLE BUCKY) NOT INSTALLED (TABLE BUCKY)
JP3	WALL BUCKY	INSTALLED (NO WALL BUCKY) NOT INSTALLED (WALL BUCKY)
JP4 - JP8	NOT USED	NOT INSTALLED
–	ROTOR BOOST STATOR VOLTAGE	INSTALL ON 1 & 2 (TOSHIBA E7242X, E7813X, E7252X, E7239X TUBES) INSTALL ON 2 & 3 (ALL OTHER TUBE TYPES)

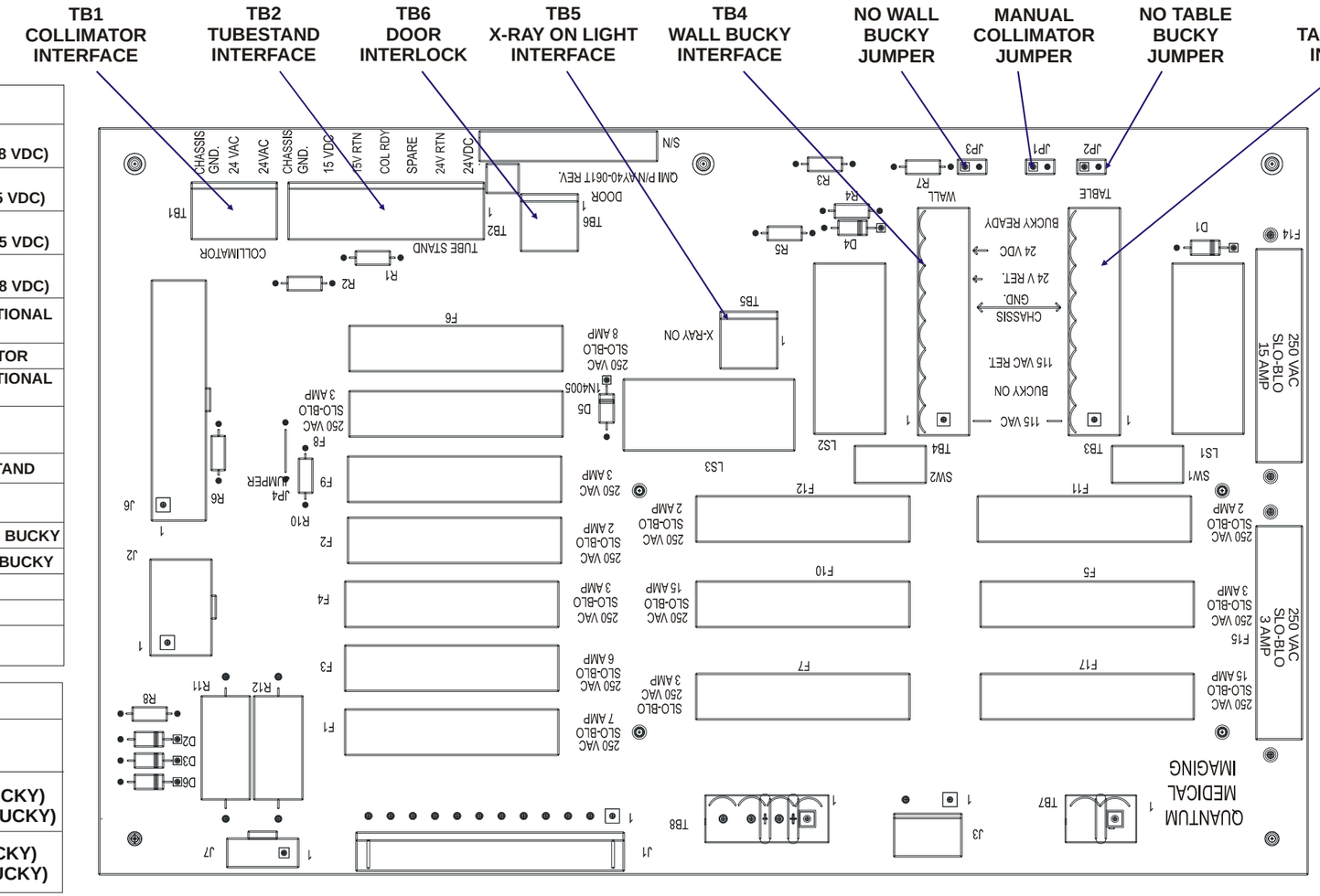


NOTE: " " DENOTES JUMPER LOCATION

Figure 6-51. Digital Interface Board (No HSS with Digital Receptor) A9 (AY40-034T) - Terminal Block/ Jumper Location Diagram

FUSE	RATING	FUNCTION
F1	7A, 250 VAC SLO-BLO	32 VAC TO POWER SUPPLY BD. (FOR +48 VDC)
F2	2A, 250 VAC SLO-BLO	15 VAC TO POWER SUPPLY BD. (FOR -15 VDC)
F3	6A, 250 VAC SLO-BLO	10.5 VAC TO POWER SUPPLY BD. (FOR +15 VDC)
F4	3A, 250 VAC SLO-BLO	24 VAC TO POWER SUPPLY BD. (FOR +28 VDC)
F5	3A, 250 VAC SLO-BLO (REPLACE ONLY WITH BUSSMAN MDA-3)	LINE INPUT FOR OPTIONAL POWER SUPPLY
F6	8A, 250 VAC SLO-BLO	24 VAC TO COLLIMATOR
F7	3A, 250 VAC SLO-BLO (REPLACE ONLY WITH BUSSMAN MDA-3)	LINE INPUT FOR OPTIONAL POWER SUPPLY
F8	3A, 250 VAC SLO-BLO	8 VAC TO LOGIC BD. (FOR +5 VDC)
F9	3A, 250 VAC FAST-ACT	+24 VDC TO TUBE STAND
F10	15A, 250 VAC SLO-BLO (REPLACE ONLY WITH BUSSMAN MDA-15)	LINE INPUT FOR TRANSFORMER T2
F11	2A, 250 VAC SLO-BLO	120 VAC FOR TABLE BUCKY
F12	2A, 250 VAC SLO-BLO	120 VAC FOR WALL BUCKY
F14	15A, 250 VAC SLO-BLO	SPARE
F15	3A, 250 VAC SLO-BLO	SPARE
F17	15A, 250 VAC SLO-BLO (REPLACE ONLY WITH BUSSMAN MDA-15)	LINE INPUT FOR TRANSFORMER T2

JUMPER DESIG.	FUNCTION	SETTING
JP1	MAN./AUTO COLL.	INSTALLED (MANUAL) NOT INSTALLED (AUTO)
JP2	TABLE BUCKY	INSTALLED (NO TABLE BUCKY) NOT INSTALLED (TABLE BUCKY)
JP3	WALL BUCKY	INSTALLED (NO WALL BUCKY) NOT INSTALLED (WALL BUCKY)

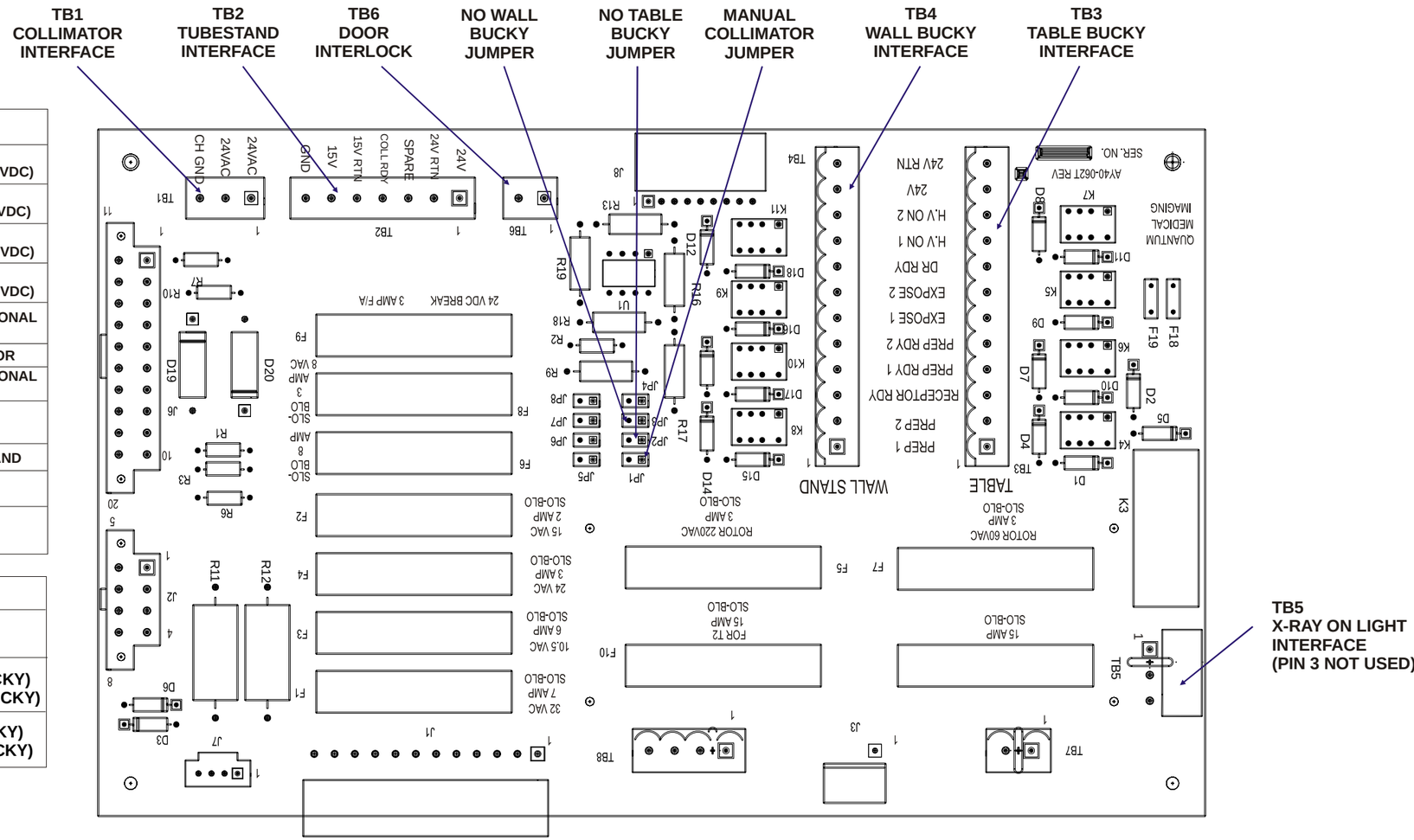


NOTE: " " DENOTES JUMPER LOCATION

Figure 6-52. Interface Board (HSS Non-Digital) A9 (AY40-061T) Terminal Block/Jumper Location Diagram

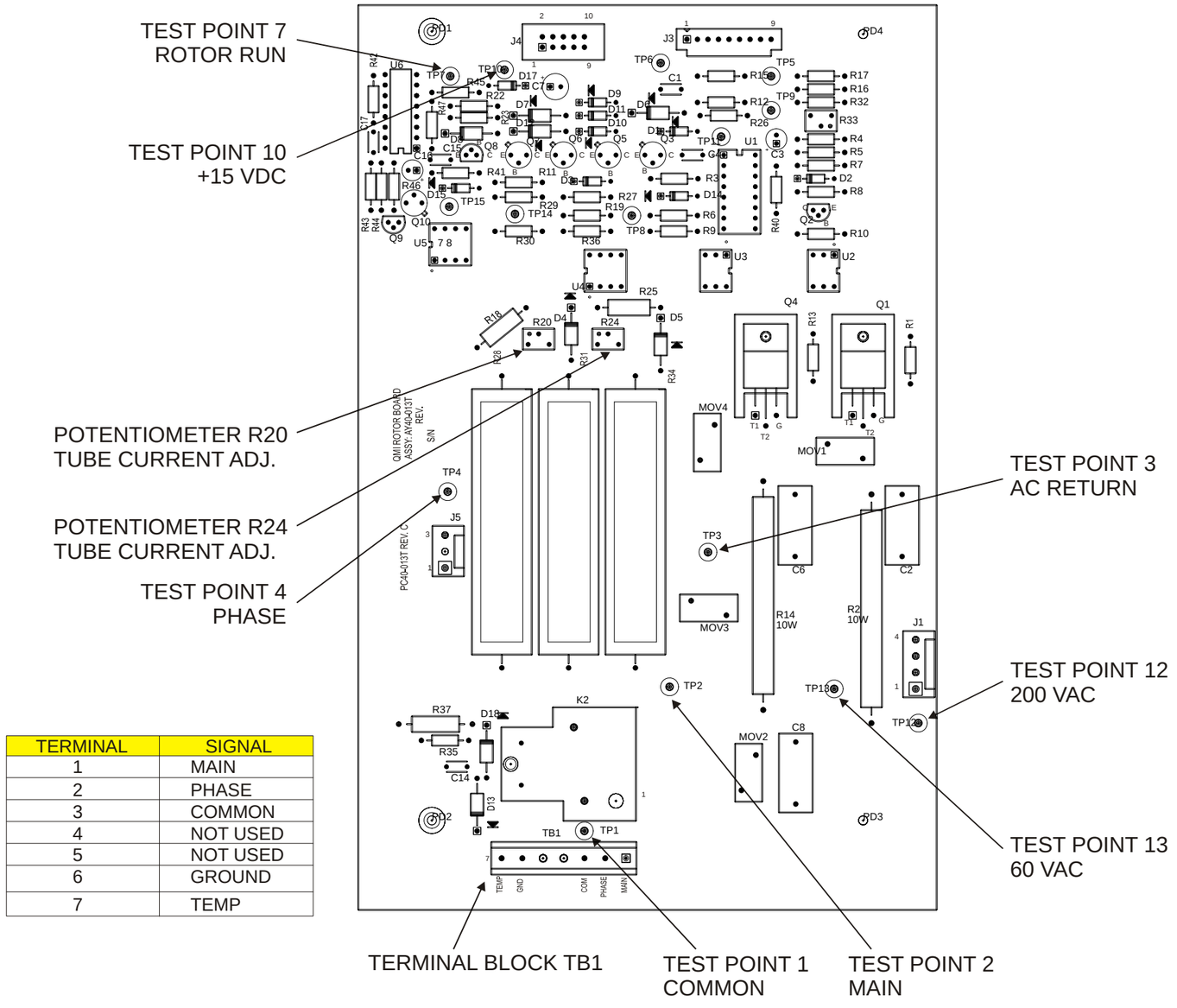
FUSE	RATING	FUNCTION
F1	7A, 250 VAC SLO-BLO	32 VAC TO POWER SUPPLY BD. (FOR +48 VDC)
F2	2A, 250 VAC SLO-BLO	15 VAC TO POWER SUPPLY BD. (FOR -15 VDC)
F3	6A, 250 VAC SLO-BLO	10.5 VAC TO POWER SUPPLY BD. (FOR +15 VDC)
F4	3A, 250 VAC SLO-BLO	24 VAC TO POWER SUPPLY BD. (FOR +28 VDC)
F5	3A, 250 VAC SLO-BLO (REPLACE ONLY WITH BUSSMAN MDA-3)	LINE INPUT FOR OPTIONAL POWER SUPPLY
F6	8A, 250 VAC SLO-BLO	24 VAC TO COLLIMATOR
F7	3A, 250 VAC SLO-BLO (REPLACE ONLY WITH BUSSMAN MDA-3)	LINE INPUT FOR OPTIONAL POWER SUPPLY
F8	3A, 250 VAC SLO-BLO	8 VAC TO LOGIC BD. (FOR +5 VDC)
F9	3A, 250 VAC FAST-ACT	+24 VDC TO TUBE STAND
F10	15A, 250 VAC SLO-BLO (REPLACE ONLY WITH BUSSMAN MDA-15)	LINE INPUT FOR TRANSFORMER T2
F17	15A, 250 VAC SLO-BLO (REPLACE ONLY WITH BUSSMAN MDA-15)	LINE INPUT FOR TRANSFORMER T2

JUMPER DESIG.	FUNCTION	SETTING
JP1	MAN./AUTO COLL.	INSTALLED (MANUAL) NOT INSTALLED (AUTO)
JP2	TABLE BUCKY	INSTALLED (NO TABLE BUCKY) NOT INSTALLED (TABLE BUCKY)
JP3	WALL BUCKY	INSTALLED (NO WALL BUCKY) NOT INSTALLED (WALL BUCKY)



NOTE: " " DENOTES JUMPER LOCATION

Figure 6-53. Digital Interface Board (HSS with Digital Receptor) A9 (AY40-062T) Terminal Block/Jumper Location Diagram



TERMINAL	SIGNAL
1	MAIN
2	PHASE
3	COMMON
4	NOT USED
5	NOT USED
6	GROUND
7	TEMP

Figure 6-54. Rotor Drive Board A10 (AY40-013T) - Terminal Block Location Diagram

JUMPER DESIG.	FUNCTION	SETTING
JP7	1 PANEL/2 PANEL SELECT	INSTALL ON 1 & 2 (SINGLE CXDI-50G PANEL USED WITH TWO ION CHAMBERS) 1 2 3 JP7 INSTALL ON 2 & 3 (ALL OTHER CONFIGS.) 1 2 3 JP7

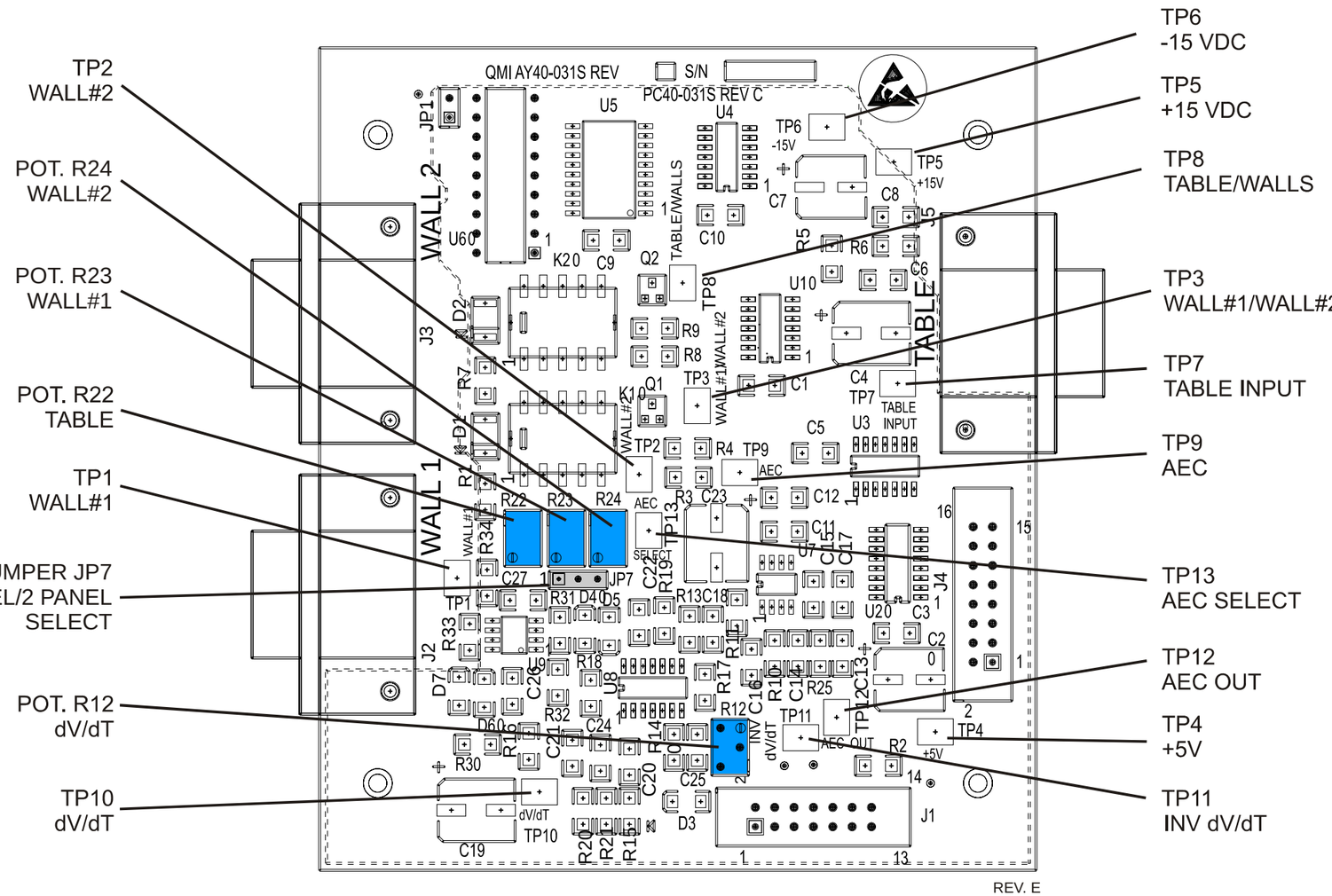


Figure 6-55. Standard AEC Board A11 (AY40-031S) - Test Point/Jumper Location Diagram

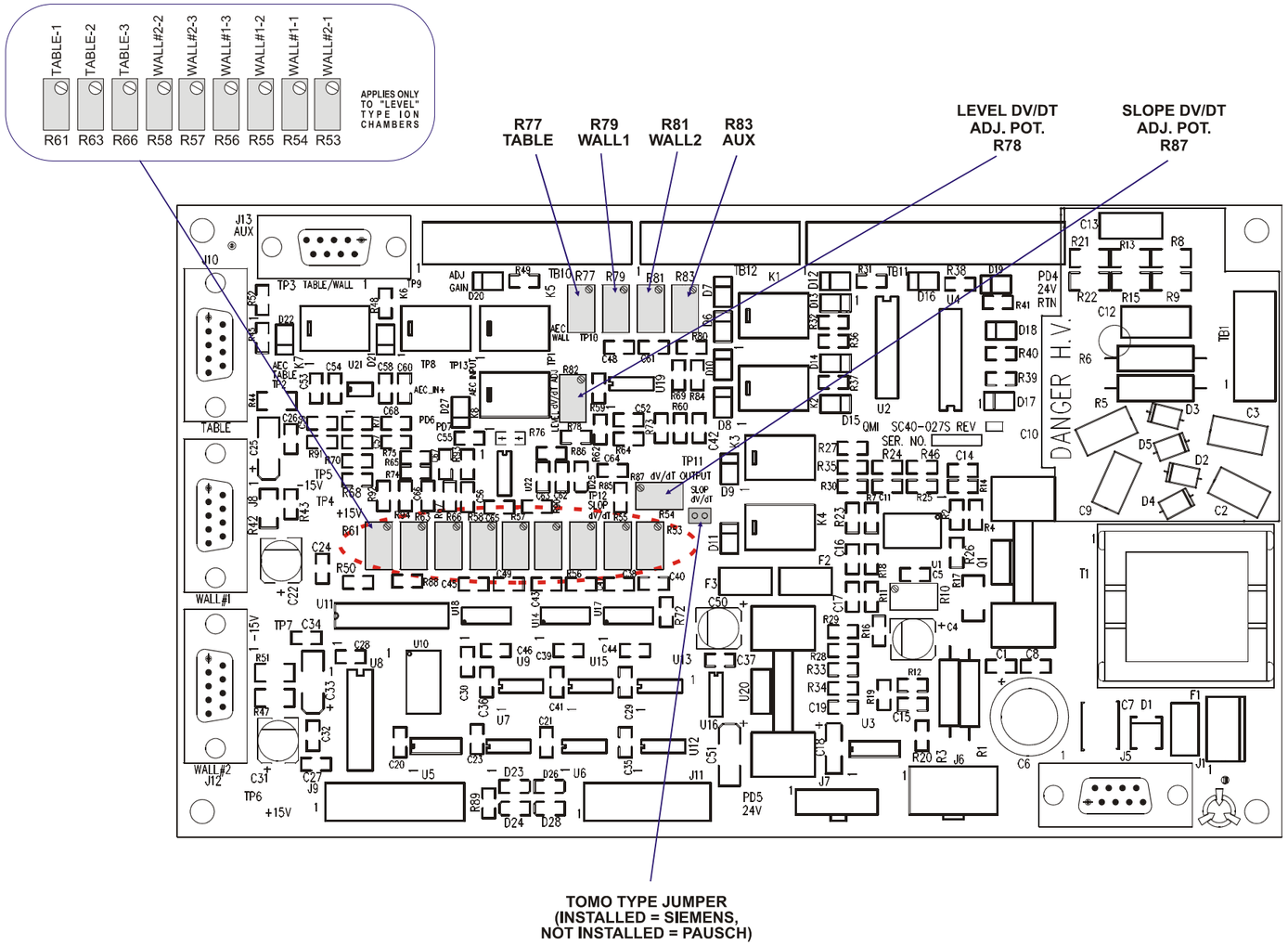


Figure 6-56. Universal AEC Board A11 (AY40-027S) - Test Point/Jumper Location Diagram

JUMPER	QUEST	ODYSSEY
A16A1JP1	INSTALLED	INSTALLED
A16A1JP6*	INSTALLED	INSTALLED
A16A1JP7*	INSTALLED	INSTALLED
A16A1JP8	NOT INSTALLED	NOT INSTALLED
A16A1JP9	NOT INSTALLED	NOT INSTALLED
A16A1JP10	INSTALLED	INSTALLED
A16A1JP11	INSTALLED	INSTALLED
A16A1JP12	INSTALLED	NOT INSTALLED
A16A1JP16**	INSTALL ON PINS 2 & 3	INSTALL ON PINS 1 & 2

*NOTE 1: DO NOT INSTALL JP6 AND JP7 TO DISABLE OCP EXPOSE BUTTON (SUCH AS WHEN USING AN OPTIONAL REMOTE HAND SWITCH)

*NOTE 2: A16A1JP16 IS INSTALLED ON PINS 2 AND 3 ONLY IF OPERATOR CONTROL PANEL BOARD HAS AN ATTACHED "PIGTAIL" RIBBON CABLE AND CONNECTOR; OTHERWISE INSTALL ON PINS 1 AND 2.

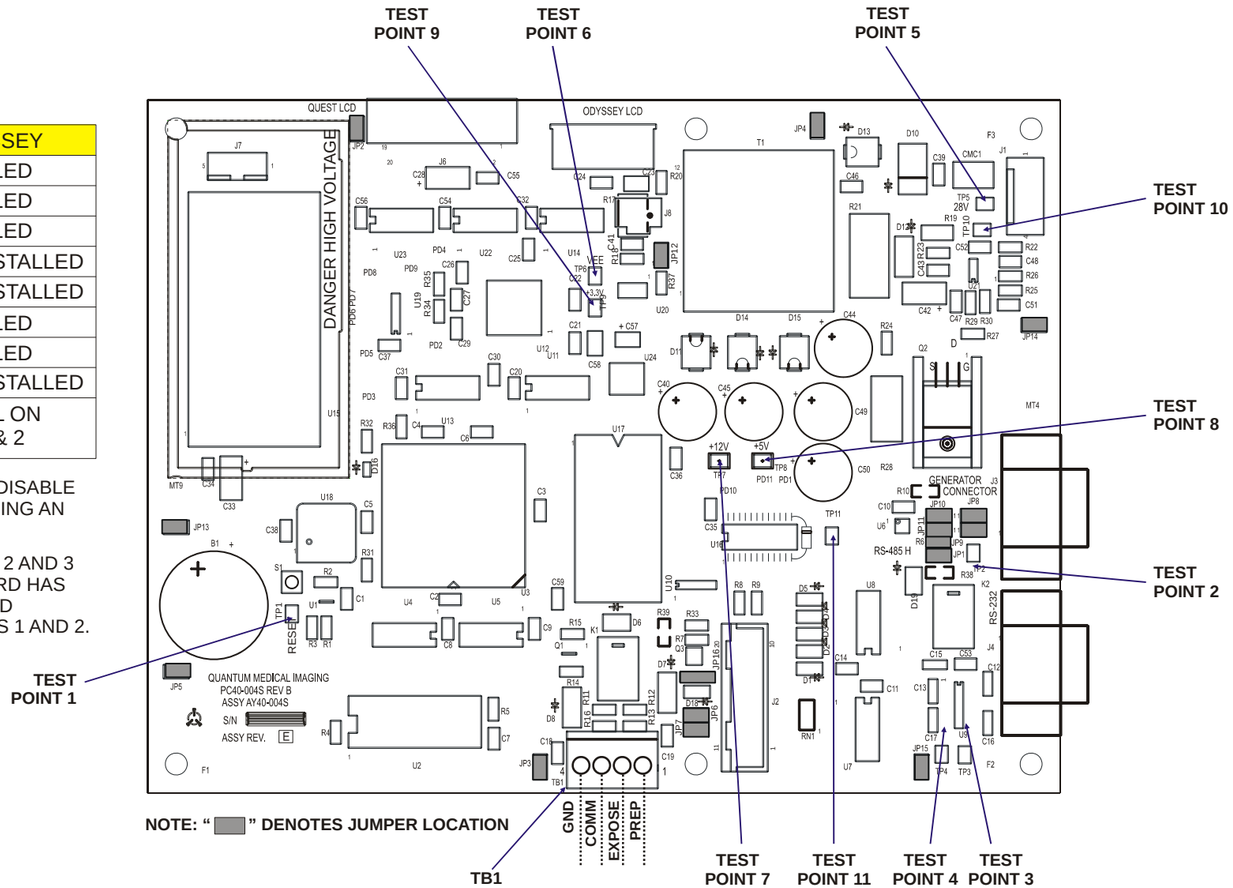
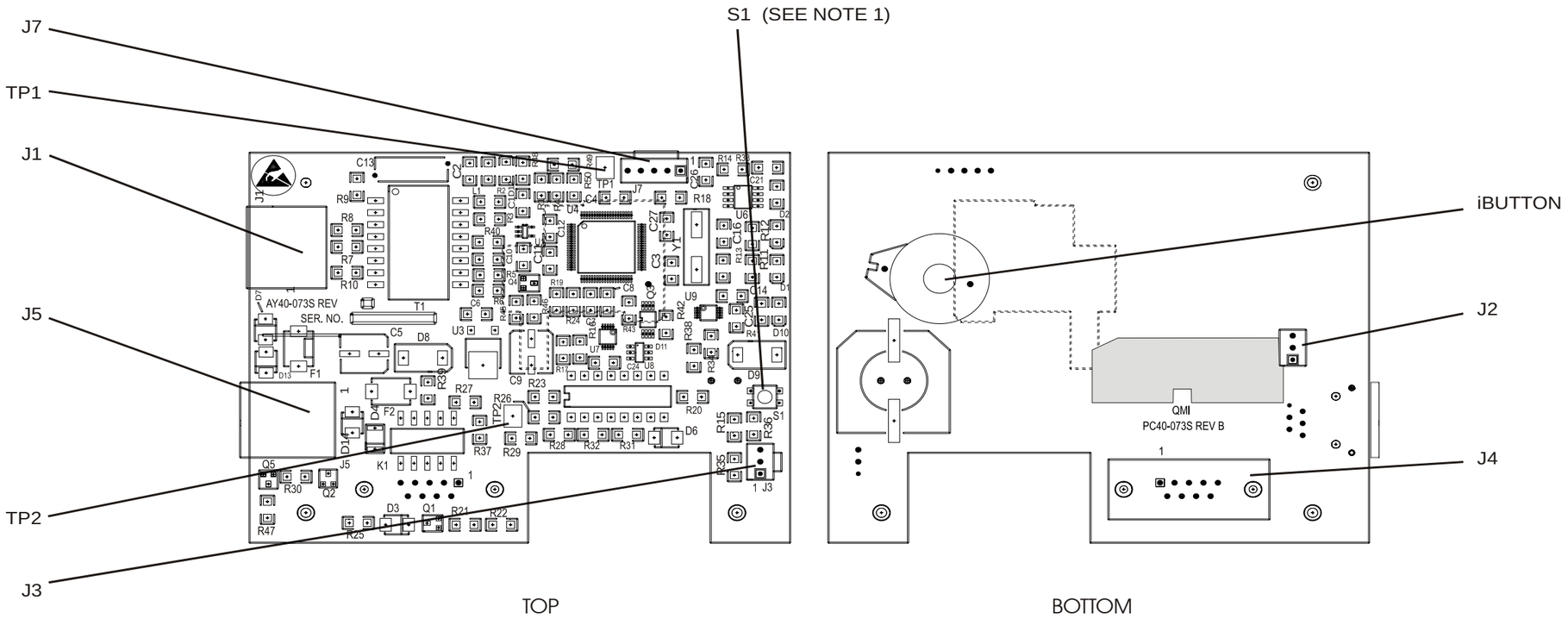


Figure 6-57. OCP Control Board A16A1 (AY40-004S1) - Test Point/Jumper Location Diagram



NOTE:
IP ADDRESS RESET SWITCH - POWER OFF GENERATOR,
THEN POWER ON WHILE HOLDING DOWN S1. RELEASE S1
WHEN YEL (D2), GRN (D1), & BLUE LEDS (D10) ARE ILLUMINATED.
IP ADDRESS OF OCP INTERFACE BD. (Q-NODE) IS NOW 10.0.0.175.

Figure 6-58. OCP Interface Board A1A1 (AY40-073S) - Test Point/Jumper Location Diagram

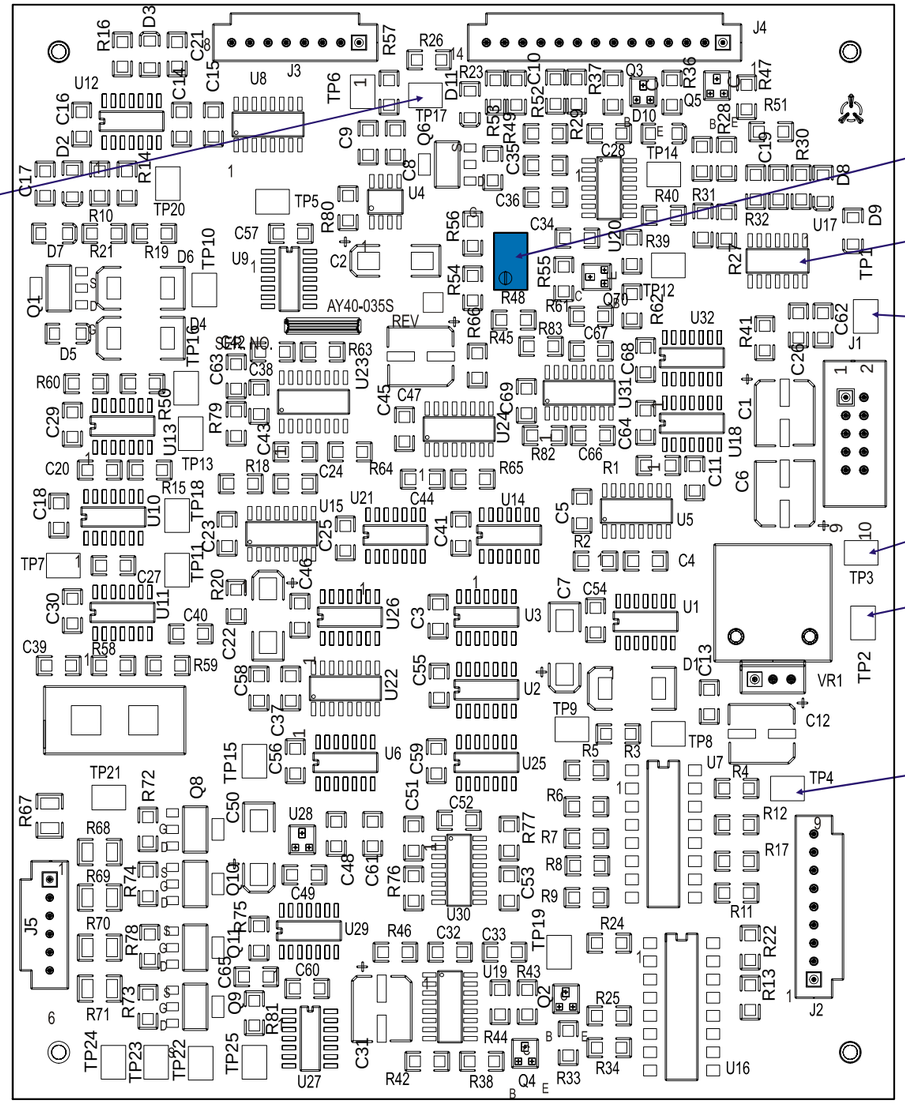


Figure 6-59. QMI High-Speed Starter Control Board A20A1 (AY40-035S) - Test Point/Potentiometer Location Diagram

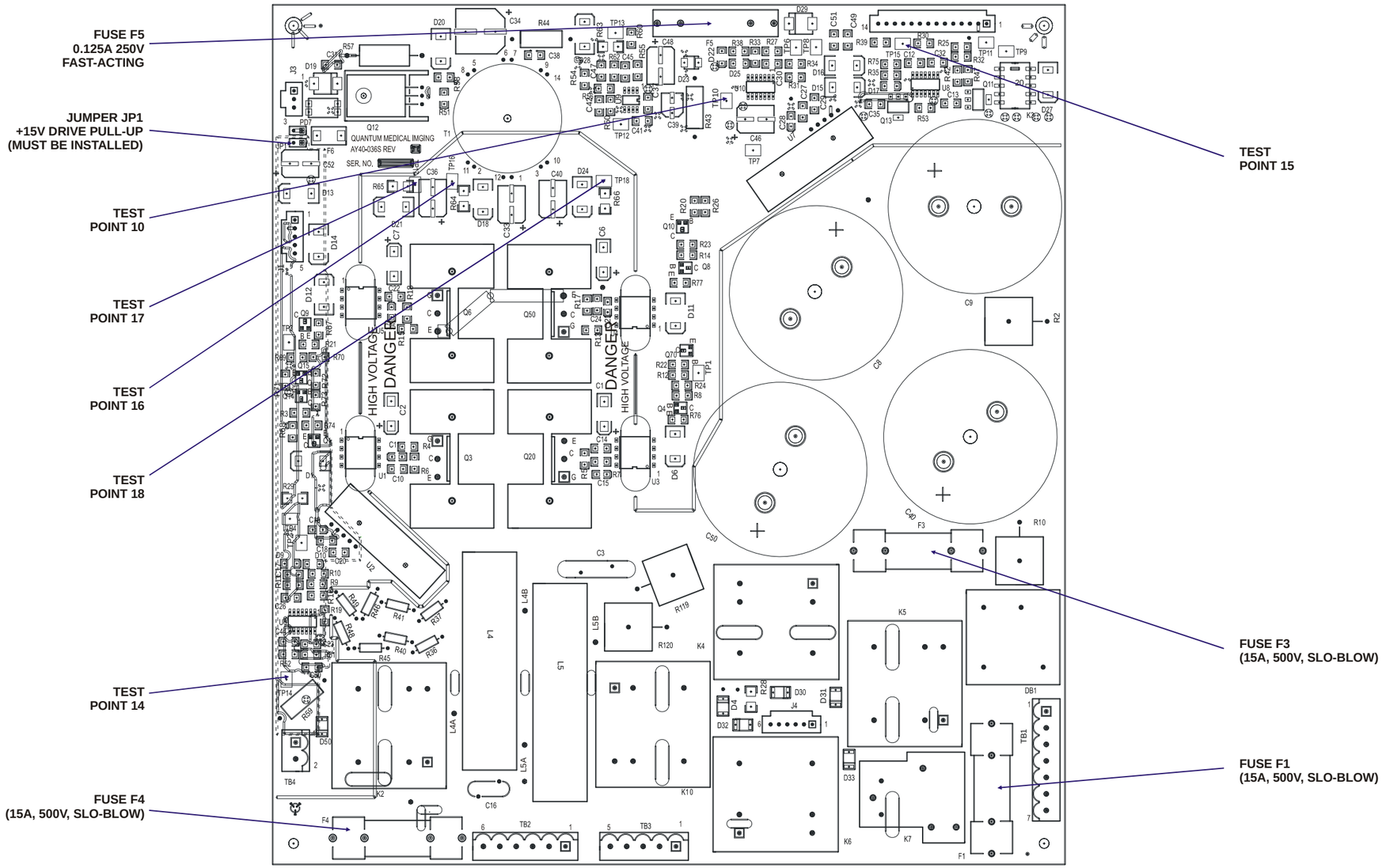


Figure 6-60. QMI High-Speed Starter Driver Board A20A2 (AY40-036S) - Test Point/Fuse Location Diagram

Appendix A

AEC CALIBRATION WITH DIGITAL RECEPTOR OR CR FILM PLATE

(NOT APPLICABLE ON GENERATORS EQUIPPED WITH Q-CONNECT OPTION)

Appendix A AEC Calibration with DR or CR Film Plate

OVERVIEW

This appendix provides instructions for successful AEC calibration of the HF Series X-ray generator when configured for operation with either:

- a digital receptor (DR) panel and the generator is not equipped with an ethernet adapter (i.e., no Q-Connect option)
- any non-integrated computed radiography (CR) system.

For additional information, refer to the DR or CR system manufacturer's installation and operation documentation.

If the HF Series X-ray generator is integrated with an Agfa CR System (i.e., DiRex System), refer to Appendix B, CALIBRATION (DiRex System) for generator configuration and calibration instructions.
If the HF Series X-ray generator is integrated with an Agfa NX-DR SeriesDigital Imaging System, a QG-DIG-CXDI Canon/Quantum Integration or has a Q-VISION operator control panel, refer to Appendix D, CALIBRATION (Using Insight) for generator configuration and calibration instructions.

CAUTION! Before calibrating unit, perform warm-up procedures recommended by tube manufacturer or the warm-up procedure described in Chapter 3 of the Operator's Manual.

SPECIAL CANON DR SYSTEM CONFIGURATION INSTRUCTIONS

When the HF Series X-ray generator is used with a fixed Canon CXDI-40G or portable CXDI-50G (or CXDI-50C) digital radiographic receptor, the generator configuration settings must be correct to ensure proper functionality of the associated ion chamber(s) used in the system. Prior to the performance of AEC calibration, it is assumed the Quantum/Canon Integration Software (QG-DIG-CXDI) has been installed and configured in accordance with the instructions provided in Quantum/Canon Integration Guide DC30-058.

Verify the following generator settings are correct for your configuration:

1. Locate jumper JP7 on AEC Board A11 (AY40-031S) on the generator PCB Door (refer to Chapter 6, DIAGRAMS for the PC board layout).
2. If a CXDI-50G (or CXDI-50C) portable DR receptor is used in the system and will be operated such that it can be located in more than one receptor containing an ion chamber (e.g., example, a table with ion chamber and a chest stand with ion chamber), verify Jumper JP7 is installed across pins 1 and 2. **All other configurations require Jumper JP7 be installed across pins 2 and 3**.
3. If a CXDI-50G (or CXDI-50C) portable DR receptor is used in the system, and will be operated such that it can be located in more than one receptor containing an ion chamber, the ion chamber signal cables must be connected to the WALL1 (A11J2) and WALL2 (A11J3) connectors on AEC Board A11. **Do not connect either ion chamber cable to the TABLE (A11J5) connec-**

tor, even if it is from a chamber located in the table.

4. At the generator OCP, access the Edit Digital screen (shown below) from the Service Configuration Menu.

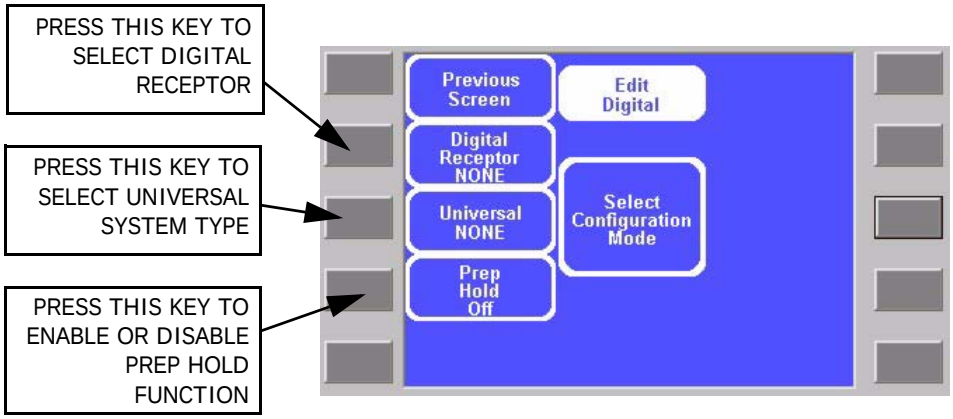

PRESS THIS KEY TO SELECT DIGITAL RECEPTOR
PRESS THIS KEY TO SELECT UNIVERSAL SYSTEM TYPE
PRESS THIS KEY TO ENABLE OR DISABLE PREP HOLD FUNCTION
Previous Screen
Edit Digital
Digital Receptor NONE
Universal NONE
Select Configuration Mode
Prep Hold Off

Figure A-1. Edit Digital Screen

5. Press the key located next to the **Digital Receptor** field until **Canon** is displayed.
6. If a CXDI-50G (or CXDI-50C) portable DR receptor is used in the system, and will be operated such that it can be located in more than one receptor containing an ion chamber, press the key next to the **Universal** setting until **QV-800** is displayed. Otherwise, set to **NONE**.
7. Set the **Prep Hold** setting to **ON** (notifies the DR system that a Prep cycle has been initiated; the generator must receive a "Prep Hold Release" signal from the DR system to proceed with the Expose cycle).
8. If a CXDI-50G (or CXDI-50C) portable DR receptor is used in the system, at the Canon workstation computer, access the Quantum/Canon Integration Software (QG-DIG-CXDI) Service Menu. Press the **Select Receptor Connection** button and verify "50G Cassette" field is set to "WALL". (Refer to Quantum/Canon Integration Guide DC30-058.)

AEC CALIBRATION WITH DIGITAL RECEPTOR OR CR FILM PLATE INSTALLED

WARNING! The following calibration procedures involve taking x-ray exposures. All personnel should be behind the protective barriers. X-rays can be dangerous unless proper precautions and procedures are adhered to.

IMPORTANT! Before performing AEC calibration procedure, verify the correct Film/Screen is displayed on the calibration screen (shown in top left field). The Film/Screen setting is selected in the

Appendix A AEC Calibration with DR or CR Film Plate

AEC Calibration Menu.

In most DR or CR film plate systems, the entire imaging area of the digital receptor or CR film plate must be covered with acrylic in order to obtain accurate "S" or "REX" values used for the procedures that follow. Refer to the calibration instructions provided with digital or CR system for specific "S" or "REX" values required for AEC calibration.

The paragraphs that follow describe AEC calibration procedures when a digital receptor or a CR film plate is installed in the generator system. Two separate calibration procedures are provided depending on the system configuration:

- The first procedure shall be performed when the generator is used with a single or dual receptor panel system, integrated or non-integrated with the generator, and each of the receptor panels is only used with one ion chamber. An example of this would be a table and wall stand system each equipped with a DR panel (or grid cabinet for CR) and ion chamber. Use this procedure for calibrating all CR Film Plate systems.
- The second procedure is intended for use with a single receptor panel system (e.g., CXDI-50G or CXDI-50C portable receptor), integrated with the generator, where the single DR panel can be used with more than one ion chamber. An example of this would be a table (with ion chamber) and wall stand (with ion chamber) system, used with a single Canon CXDI-50G or CXDI-50C portable receptor.

Table A-1 shows a summarized presentation of the AEC calibration procedure. An AEC calibration Worksheet is provided in Table A-2 for recording calibration data.

Table A-1. DR or CR System AEC Calibration Procedure Sequence

FILM/SCREENS TO BE CALIBRATED	REQUIRED AEC CALIBRATION PROCEDURES/ SPECIAL INSTRUCTIONS
WALL STAND 72" SID FILM/SCREEN (SLOWEST SPEED, LARGEST SID)	1. Perform "Ion Chamber Balancing" procedure. 2. Perform "AEC MAS Balance" procedure for wall stand ion chamber. 3. Perform "AEC Optical Density (OD) Calibration": a. Set desired "base" optical density b. Set "AEC Ref" to 2000. c. Adjust ion chamber's MASTER GAIN potentiometer until base optical density is achieved in developed films. 4. Perform "AEC KV Calibration".

Appendix A AEC Calibration with DR or CR Film Plate

Table A-1. DR or CR System AEC Calibration Procedure Sequence

FILM/SCREENS TO BE CALIBRATED	REQUIRED AEC CALIBRATION PROCEDURES/ SPECIAL INSTRUCTIONS
WALL STAND 40" SID FILM/SCREEN	1. Copy "Wall 72" film/screen to "Wall 40". 2. Perform "AEC Optical Density (OD) Calibration", however, **DO NOT** re-adjust the ion chamber MASTER GAIN potentiometer. Adjust "AEC Ref" to obtain desired (set) optical density. 3. Perform "AEC KV Calibration".
TABLE 40" SID FILM/ SCREEN	1. If system includes a wall stand, copy "Wall 40" film/screen to "Table 40". 2. Perform "Ion Chamber Balancing" procedure for table ion chamber. 3. Perform "AEC Optical Density (OD) Calibration": a. Set desired "base" optical density b. Set "AEC Ref" to 2000. c. Adjust ion chamber's MASTER GAIN potentiometer until base optical density is achieved in developed films. 4. Perform "AEC KV Calibration".

Appendix A AEC Calibration with DR or CR Film Plate

Table A-2. AEC Calibration Worksheet

Film/Screen Combination:	Table 40	Wall 40	Wall 72
AEC OD CALIBRATION			
Setting:	**50 kVp, 200L mA, 5 cm**		
Optical Density:			
Sensitivity (REX) Value			
AEC Ref.			
AEC KV CALIBRATION			
Setting:	**Step 1 - 50 kVp, 200L mA, 5 cm**		
Optical Density:			
Sensitivity (REX) Value			
Setting:	**Step 2 - 60 kVp, 200L mA, 10 cm**		
Optical Density:			
Sensitivity (REX) Value			
Setting:	**Step 3 - 80 kVp, 200L mA, 15 cm**		
Optical Density:			
Sensitivity (REX) Value			
Setting:	**Step 4 - 100 kVp, 200L mA, 20 cm**		
Optical Density:			
Sensitivity (REX) Value			
Setting:	**Step 5 - 110 kVp, 200L mA, 25 cm**		
Optical Density:			
Sensitivity (REX) Value			
Setting:	**Step 6 - 120 kVp, 200L mA, 30 cm**		
Optical Density:			
Sensitivity (REX) Value			
Setting:	***Step 7 - 130 kVp, 200L mA, 30 cm**		
Optical Density:			
Sensitivity (REX) Value			
Setting:	***Step 8 - 140 kVp, 200L mA, 30 cm**		
Optical Density:			
Sensitivity (REX) Value			

* Only required on 150 kVp systems

Appendix A AEC Calibration with DR or CR Film Plate

AEC Calibration Instructions - One Ion Chamber Per Panel

The following procedure is used to perform AEC calibration of generators used with a single or dual receptor panel, integrated or non-integrated, and each of the receptor panels is only used with one ion chamber. Use this procedure for calibrating all CR Film Plate systems.

1. Verify system is configured correctly per "CANON DR SYSTEM CONFIGURATION INSTRUCTIONS" procedure provided in this appendix.
2. Place a CR film plate in the tray (if CR system) and collimate down to film size.
3. If not already done so, access the AEC Calibration Menu (refer to Chapter 3).
4. Press the key next to the **Film/Screen Combination** field (upper left field) to select a film/screen combination to calibrate (e.g., "TABLE 40").
5. The **FILM SPEED** field shows the default film speed setting for the selected film/screen combination (400). If not, press the up or down keys next to the **FILM SPEED** field until **400** film speed setting is displayed.
6. When film/screen combination name and film speed settings are correct, press the key next to the **AEC OD Calibration** field to proceed with AEC Calibration. The AEC Optical Density Calibration Screen is displayed:

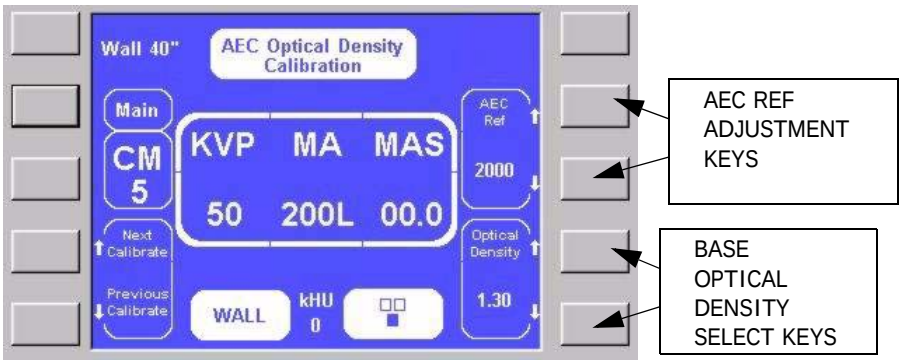


Figure A-2. AEC Optical Density Calibration Screen

7. This screen is used to calibrate the digital receptor or CR film plate to a user defined optical density setting (e.g., 1.3). This is accomplished by comparing the digital receptor or CR film plate's specified sensitivity values (refer to manufacturer's installation and calibration documentation supplied with CR film plate) with the AEC REF value appearing on AEC Optical Density Calibration screen shown above.

8. Set the ion chamber detector selection to middle detector and ensure x-ray tube is at correct SID. Ensure the ion chamber has been balanced.
9. Place 5 cm of acrylic in the X-ray beam.
10. Verify the **Optical Density** field is set to the desired optical density (e.g., "1.30"). If not, press the up or down key located next to the **Optical Density** field until the "base" optical density setting is equal to the desired optical density (1.30 in this example). *Do not change the optical density setting at any time during this procedure.*
11. Take an exposure at the setting indicated in the center display box (i.e., 50 kVp, 200L mA).
12. Process the CR film plate (if CR system) to determine sensitivity value (sometimes referred to as the "REX" or "S" value, depending on CR or DR system manufacturer).
    a. If the sensitivity value is within acceptable range as defined by the digital receptor or CR film plate manufacturer, press the Next Calibrate key to save the setting and proceed to Reciprocity Calibration.
    b. If not within range, adjust ion chamber MASTER GAIN as described in the "AEC Optical Density Calibration" procedure in Chapter 3, CALIBRATION. Note that the MASTER GAIN adjustment procedure is different depending on the generator AEC configuration (standard AEC or universal AEC).

IMPORTANT! Following a calibration procedure, unless the "Save Calibrate" or "Measure, Calibrate" key is pressed, no change is made to the currently saved calibration value(s).

13. Press the key next to the **Next Calibrate** field to advance to Reciprocity Calibration.
14. The Reciprocity Calibration Screen is displayed; however, this calibration procedure is not necessary with systems equipped with digital receptor or CR film plate.
15. Press the key next to the **Next Calibrate** field.

16. The AEC KV Calibration screen is displayed.

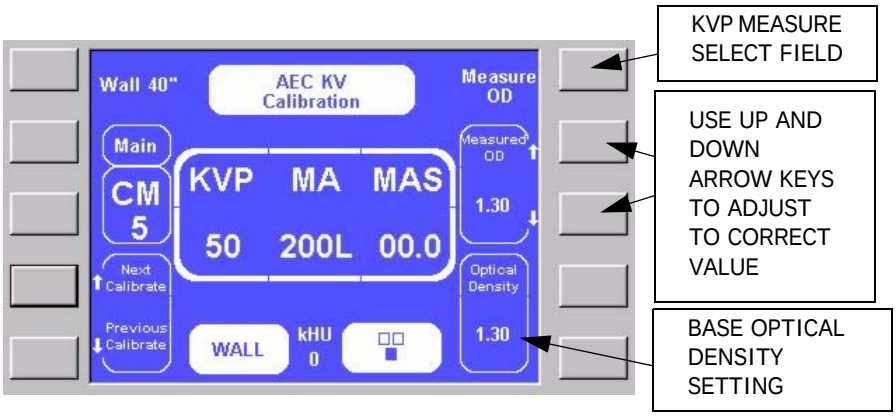


Figure A-3. AEC KV Calibration Screen

17. There are a total of six kV calibration points for a 125 kV system (50, 60, 80, 100, 110, and 120 kV); 150 kV systems require an additional two kV calibration points (130 and 140 kV). The image receptor and chamber field settings remain the same as those used in the AEC Optical Density Calibration procedure.

18. Place indicated thickness of acrylic (5 CM for first calibration point) in the X-ray beam.

19. Insert a CR film plate and collimate down to film size.

20. Take an exposure at the setting indicated in the center display box (i.e., 50 kVp, 200L mA).

21. Process the CR film plate (if CR system) to determine sensitivity value.

    a. If the sensitivity value is within acceptable range as defined by manufacturer, press the **Measured OD** field up or down adjustment keys to set the **Measured OD** value to **Base Optical Optical Density** setting (1.3, see Figure A-2). Press the **Measure OD** key to save the setting and proceed to the next kV calibration point.

    b. If not within range, press **Measured OD** field up or down adjustment keys, to increase or decrease sensitivity value. (Note: this adjustment will not be immediately seen in the image until after all AEC KVP Calibration steps are performed.) DO NOT TAKE ANY FURTHER EXPOSURES AT THIS SETTING.

22. Press the key next to the **Measure OD** field to save the first kV calibration point entry (50 kV, 5 CM). The AEC KV Calibration screen is updated for the next kV calibration point (60 kV, 10 CM).

NOTE

Calibration of the first step (50 kVp) is not required as long as AEC Optical Density Calibration procedure in the previous steps was performed prior to AEC KV Calibration. A verification that the "Measured OD" is the same as the "Optical Density" setting is only necessary.

NOTE

Decreasing the **Measured OD** value below the "Base Optical Density setting" will result in a higher sensitivity value reading of the image. Conversely, increasing the **Measured OD** value above the "Base Optical Density setting" will result in lower sensitivity value reading of the image.

23. Repeat the previous steps for the 60, 80, 100, 110, 120, and, if 150 kV system, 130 and 140 kV calibration points, placing the specified thickness of acrylic in the x-ray beam as indicated on the AEC KV Calibration screen for each kV calibration point, and taking one exposure per kVp calibration point.
24. Upon completion of the final kV calibration point (i.e., 120 kV on 125 kV systems, 140 kV on 150 kV systems), press the key next to the **Measure OD** field. The field will now display **Save Calibrate**. Press this key once again to save the calibration data for the final kV calibration point.

IMPORTANT! Unless the "Save Calibrate" key is pressed, the calibration data will not be saved.

25. Repeat AEC KVP Calibration procedure (steps 17 through 23) until all the measured sensitivity values are within required range.
26. Press the key next to the **Next Calibrate** field to return to the AEC Calibration menu.
27. This completes AEC calibration for this particular film/screen combination. Repeat AEC calibration procedures for all additional film/screen combinations that will be used with the system.
28. Verify AEC calibration by taking several exposures in AEC mode and checking the resulting "REX" or "S" value. If necessary, repeat AEC calibration procedure to further adjust AEC accuracy.

Appendix A AEC Calibration with DR or CR Film Plate

Copy Film/Screen Utility

On the AEC Calibration Menu (refer to Chapter 3, CALIBRATION), the AEC calibration data copy utility is provided (**Copy Film/Screen** key). Following calibration of the first film/screen combination, stored AEC calibration data, such as the kV curves and AEC reference data, can be copied from the first film/screen combination to other film/screen combinations used with the system to reduce calibration time. Although both the AEC Optical Density Calibration and AEC KV Calibration procedures must still be performed, this will set the calibration values for the copied film/screen combinations to fairly accurate settings, thereby reducing the number of exposures required to calibrate. Proceed as follows:

1. If not displayed, access the AEC Calibration Menu.
2. Press the key next to the Film/Screen field (upper left field) until the the film/screen combination you want to copy calibration data to is displayed.
3. Press the key next to the **Copy Film/Screen** field.
4. The following screen appears:

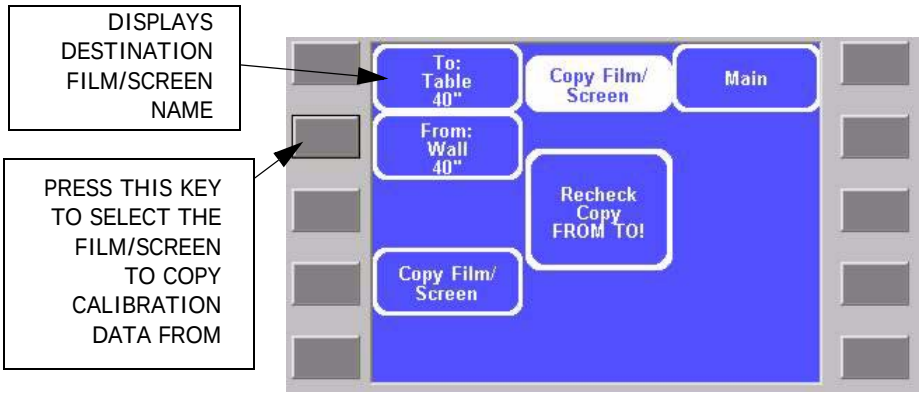

DISPLAYS DESTINATION FILM/SCREEN NAME
PRESS THIS KEY TO SELECT THE FILM/SCREEN TO COPY CALIBRATION DATA FROM
To: Table 40"
Copy Film/ Screen
Main
From: Wall 40"
Recheck Copy FROM TO!
Copy Film/ Screen

Figure A-4. Copy Film/Screen Screen

5. Copy Film/Screen Menu Screen
6. Press the key next to the "**From**" field until the name of the film/screen combination from which calibration data will be copied appears.
7. Press the key next to the **Copy Film/Screen** field. All AEC calibration data is copied from Wall 40" film/screen combination to the Table 40" film/screen combination. To abort without copying, press the key next to the **MAIN** field. The AEC Calibration Menu is displayed.
8. Perform the AEC Optical Density and AEC KV Calibration procedures as described in the previous paragraphs for each copied film/screen combination.

Appendix A AEC Calibration with DR or CR Film Plate

AEC Calibration Instructions - Single Panel, Dual Ion Chambers

The following procedure is used to perform AEC calibration of generators used with a single receptor panel system (e.g., CXDI-50G or CXDI-50C portable receptor), integrated with the generator, where the single DR panel can be used with more than one ion chamber.

Proceed as follows:

1. Verify system is configured correctly per "CANON DR SYSTEM CONFIGURATION INSTRUCTIONS" procedure provided in this appendix (in particular, "Universal" is set to "QV-800" as described in step 6).
2. Insert DR receptor in the most commonly used receptor cabinet (this cabinet's ion chamber should be connected to WALL#1 connector A11J2 on AEC Control Board) and collimate down to proper image size.
3. If not already done so, access the AEC Calibration Menu (refer to Chapter 3).
4. Press the key next to the **Film/Screen Combination** field (upper left field) to select WALL 40" film/screen combination for calibration.
5. The **FILM SPEED** field shows the default film speed setting for the selected film/screen combination (400). If not, press the up or down keys next to the **FILM SPEED** field until **400** film speed setting is displayed.
6. When film/screen combination name and film speed settings are correct, press the key next to the **AEC OD Calibration** field to proceed with AEC Calibration. The AEC Optical Density Calibration Screen is displayed:

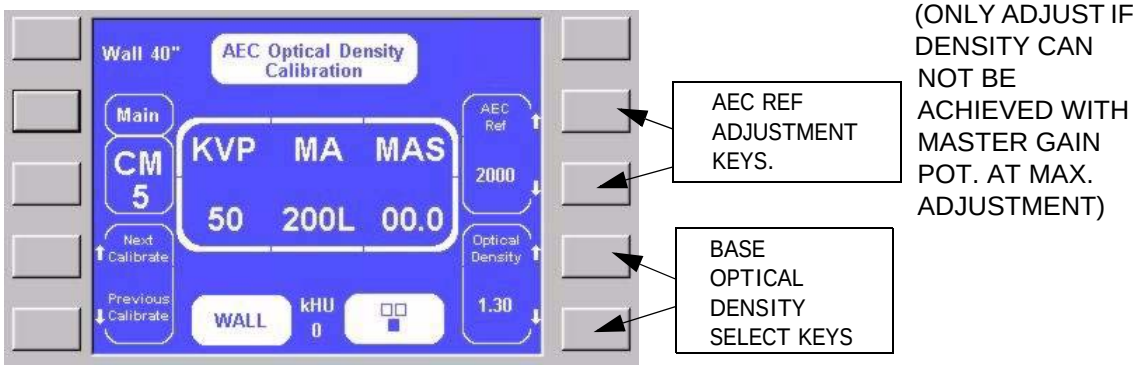


Figure A-5. AEC Optical Density Calibration Screen

7. This screen is used to calibrate the digital receptor or CR film plate to a user defined optical density setting (e.g., 1.30). This is accomplished by comparing the digital receptor's specified sensitivity values

(refer to manufacturer's installation and calibration documentation supplied with DR system) with the AEC REF value appearing in AEC Optical Density Calibration screen shown above.

8. Set the ion chamber detector selection to middle detector and ensure x-ray tube is at correct SID. Ensure the ion chamber has been balanced.
9. Verify the **Optical Density** field is set to the desired optical density (e.g., "1.30"). If not, press the up or down key located next to the **Optical Density** field until the "base" optical density setting is equal to the desired optical density (1.30 in this example). *Do not change the optical density setting at any time during this procedure.*
10. Place 5 cm of acrylic in the X-ray beam.
11. On AEC Control Board AY40-031S, adjust ion chamber MASTER GAIN potentiometer A11R22, A11R23, and A11R24 to midrange.
12. Take an exposure at the setting indicated in the center display box (i.e., 50 kVp, 200L mA).
13. Determine the sensitivity value (sometimes referred to as the "REX" or "S" value, depending on DR system manufacturer).
    a. If the sensitivity value is within acceptable range as defined by the digital receptor manufacturer, continue at step 14.
    b. If not within range, adjust the associated ion chamber's MASTER GAIN potentiometer and repeat exposure. Continue until the sensitivity ("REX" or "S") value is acceptable. Note the sensitivity value as it will be needed in a later step.
14. Move the DR receptor to the other receptor cabinet (it's ion chamber should be connected to WALL#2 connector A11J3 on AEC Control Board) and collimate down to proper image size.
15. With 5 cm of acrylic in the X-ray beam, take an exposure at the setting indicated in the center display box (i.e., 50 kVp, 200L mA).
16. Determine the sensitivity value (sometimes referred to as the "REX" or "S" value, depending on DR system manufacturer).
17. If necessary, adjust the ion chamber's MASTER GAIN potentiometer and repeat exposure until the sensitivity ("REX" or "S") value is the same as the value obtained for the previously calibrated ion chamber in step 13b.

Note: If later on it becomes necessary to adjust the optical density of either receptor's ion chamber, this should be done by adjusting potentiometer A11R23 on the AEC Control Board, and if further adjustment is needed, increasing or

decreasing the AEC REF value shown in the AEC Optical Density Calibration Screen (see Figure A-4).

IMPORTANT! Following a calibration procedure, unless the "Save Calibrate" or "Measure, Calibrate" key is pressed, no change is made to the currently saved calibration value(s).

18. Re-locate the DR receptor to the most commonly used receptor cabinet (this cabinet's ion chamber should be connected to WALL#1 connector A11J2 on AEC Control Board).
19. Press the key next to the **Next Calibrate** field to advance to Reciprocity Calibration.
20. The Reciprocity Calibration Screen is displayed; however, this calibration procedure is not necessary with systems equipped with digital receptor.
21. Press the key next to the **Next Calibrate** field.
22. The AEC KV Calibration screen is displayed.

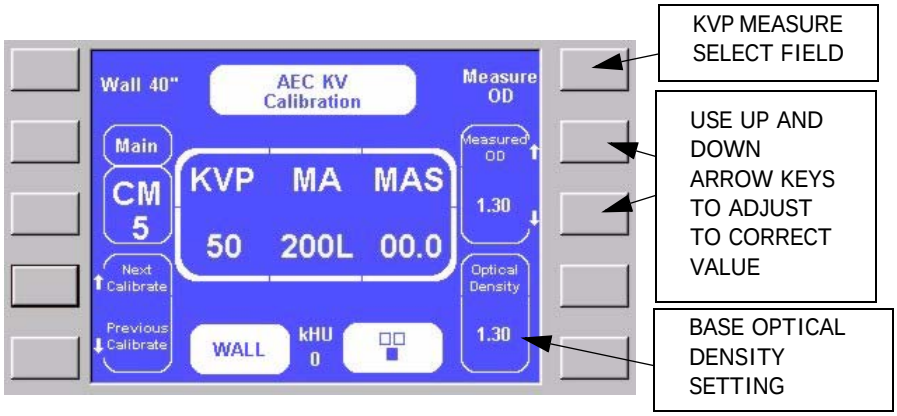


Figure A-6. AEC KV Calibration Screen

23. There are a total of six kV calibration points for a 125 kV system (50, 60, 80, 100, 110, and 120 kV); 150 kV systems require an additional two kV calibration points (130 and 140 kV). The image receptor and chamber field settings remain the same as those used in the AEC Optical Density Calibration procedure.
24. Place indicated thickness of acrylic (5 CM for first calibration point) in the X-ray beam.
25. Take an exposure at the setting indicated in the center display box (i.e., 50 kVp, 200L mA).

NOTE
Calibration of the first step (50 kVp) is not required as long as AEC Optical Density Calibration procedure in the previous steps was performed prior to AEC KV Calibration. A verification that the "Measured OD" is the same as the "Optical Density" setting is all that is required.

26. Determine the sensitivity value.

    a. If the sensitivity value is within acceptable range as defined by manufacturer, press the **Measured OD** field up or down adjustment keys to set the **Measured OD** value to **Base Optical Optical Density** setting (1.3, see Figure A-2). Press the **Measure OD** key to save the setting and proceed to the next kV calibration point.

    b. If not within range, press **Measured OD** field up or down adjustment keys, to increase or decrease sensitivity value. (Note: this adjustment will not be immediately seen in the image until after all AEC KVP Calibration steps are performed.) DO NOT TAKE ANY FURTHER EXPOSURES AT THIS SETTING.

27. Press the key next to the **Measure OD** field to save the first kV calibration point entry (50 kV, 5 CM). The AEC KV Calibration screen is updated for the next kV calibration point (60 kV, 10 CM).

28. Repeat the previous steps for the 60, 80, 100, 110, 120, and, if 150 kV system, 130 and 140 kV calibration points, placing the specified thickness of acrylic in the x-ray beam as indicated on the AEC KV Calibration screen for each kV calibration point, and taking one exposure per kVp calibration point.

29. Upon completion of the final kV calibration point (i.e., 120 kV on 125 kV systems, 140 kV on 150 kV systems), press the key next to the **Measure OD** field. The field will now display **Save Calibrate**. Press this key once again to save the calibration data for the final kV calibration point.

IMPORTANT! Unless the "Save Calibrate" key is pressed, the calibration data will not be saved.

30. Repeat AEC KVP Calibration procedure (steps 17 through 23) until all the measured sensitivity values are within required range.

31. Press the key next to the **Next Calibrate** field to return to the AEC Calibration menu.

32. This completes AEC calibration for this particular film/screen combination. Repeat AEC calibration procedures for all additional film/screen combinations that will be used with the system.

33. Verify AEC calibration by taking several exposures in AEC mode and checking the resulting "REX" or "S" value. If necessary, repeat AEC calibration procedure to further adjust AEC accuracy.

NOTE

Decreasing the **Measured OD** value below the "Base Optical Density setting" will result in a higher sensitivity value reading of the image. Conversely, increasing the **Measured OD** value above the "Base Optical Density setting" will result in lower sensitivity value reading of the image.

Appendix B

CALIBRATION (Agfa DiRex)

THIS SECTION
NOT APPLICABLE
TO QUEST, E-ZVET, Q-VISION, &
TOSHIBA HF SERIES GENERATORS

Appendix B Calibration (DiRex System)

OVERVIEW

This appendix provides instructions for configuring and calibrating the HF Series X-ray generator using DiRex interface program installed on the Agfa CR system's workstation computer (refer to DiRex Service Manual DC30-088 for system interconnection and software OCP installation instructions). With DiRex, the workstation computer functions as the generator operator control panel (OCP). The X-ray generator must be equipped with the "Q-Connect option" (i.e., CR/DR system integration) to enable DiRex functionality.

NEMA Standards Publication/No. XR8-1979(R1994), Test Methods for Diagnostic X-ray Machines for Use During Initial Installation is recommended as a reference.

REQUIRED TOOLS AND MATERIALS

The following lists the tools and materials required to perform the procedures contained in this chapter:

- Digital Voltmeter: Fluke Model 87 (or equivalent)
- Non-invasive kV, mAs, mR meter or Radcal Dynalyzer III (or equivalent)
- Oscilloscope, 50 Mhz storage: Tek 2210 (or equivalent)
- 5 CM, 10 CM, 15 CM, 25 and 30 CM acrylic phantoms (required for calibrating systems equipped with QG-AEC option).

SYSTEM CONFIGURATION/CALIBRATION

The HF Series x-ray generator has been factory configured and calibrated. It is necessary, however, to perform the following procedures to verify system performance. Perform the procedures in the sequence presented, unless otherwise instructed.

ACCESSING SERVICE MODE

Calibration and configuration can only be performed by accessing the X-ray generator's Service Mode. To gain access to the Service Mode, password entry is required. This is to prevent unintended and/or unauthorized changes to system settings. To access the Service Options Menu, proceed as follows:

1. Ensure the DR or CR system's Computer Workstation is properly connected to the generator, and the DiRex System (i.e., Quantum/Agfa Integration) software is installed and configured in accordance with the instructions provided in DiRex Service Manual DC30-088.
2. Ensure the Power/Expose Control Box (AY20-265) is properly connected to the generator as described in Chapter 2, ASSEMBLY & INSTALLATION.
3. Set the ON/OFF circuit breaker CB1 on the generator cabinet to ON position.
4. Set the power on/standby switch on the Power/Expose Control Box to the standby (⏻) position, then to the on (⊙) position. The green power LED lamp should illuminate.

5. From the Main OCP Overlay Menu, double click the generator status icon. The "Enter Password" screen appears (see Figure 3-1.).

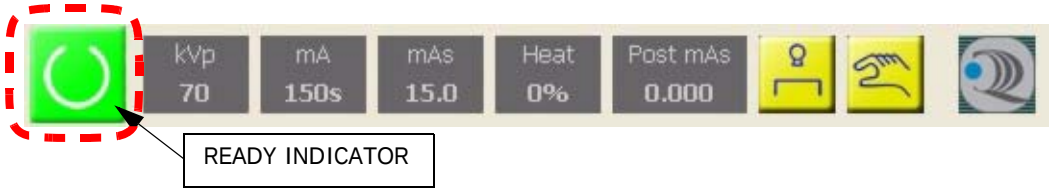


Figure B-1. Enter Password Screen

6. In the Enter Password screen, enter the default Service Technician password (**58623**) using the keypad, then press **Enter**. This password enables access to Service Mode for modification of system configuration, calibration and settings.

7. Upon validation of the password, the Service Options Menu displays:

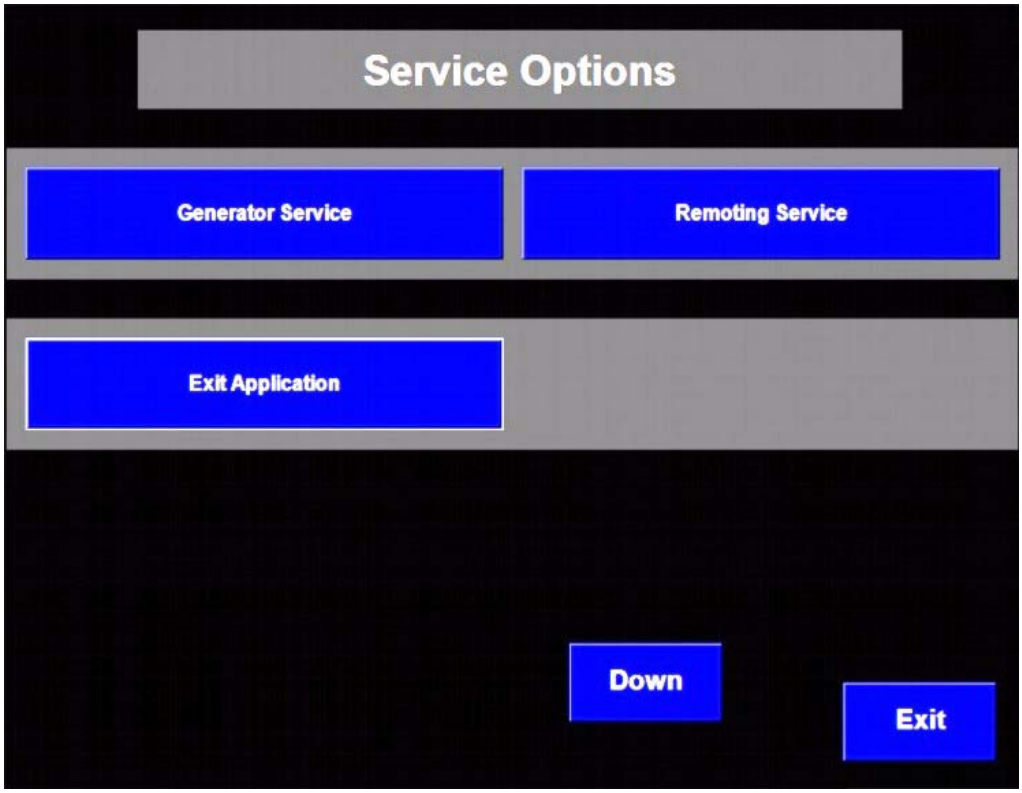


Figure B-2. Service Options Menu

The Service Options Menu offers the following selections:

- **Generator Service** - Accesses the generator configuration, generator calibration, Factory Reset, and Statistics utilities.
- **Remoting Service** - Accesses the Device Settings and System Settings utilities. (These utilities are described in detail in the DiRex Service Manual DC30-088.)
- **Exit Application** - Exits the Quantum generator OCP software application (the Main OCP Overlay Menu will no longer appear on the Workstation Computer)

Press the Generator Service button to continue with generator configuration and calibration. The Generator Service Menu appears:

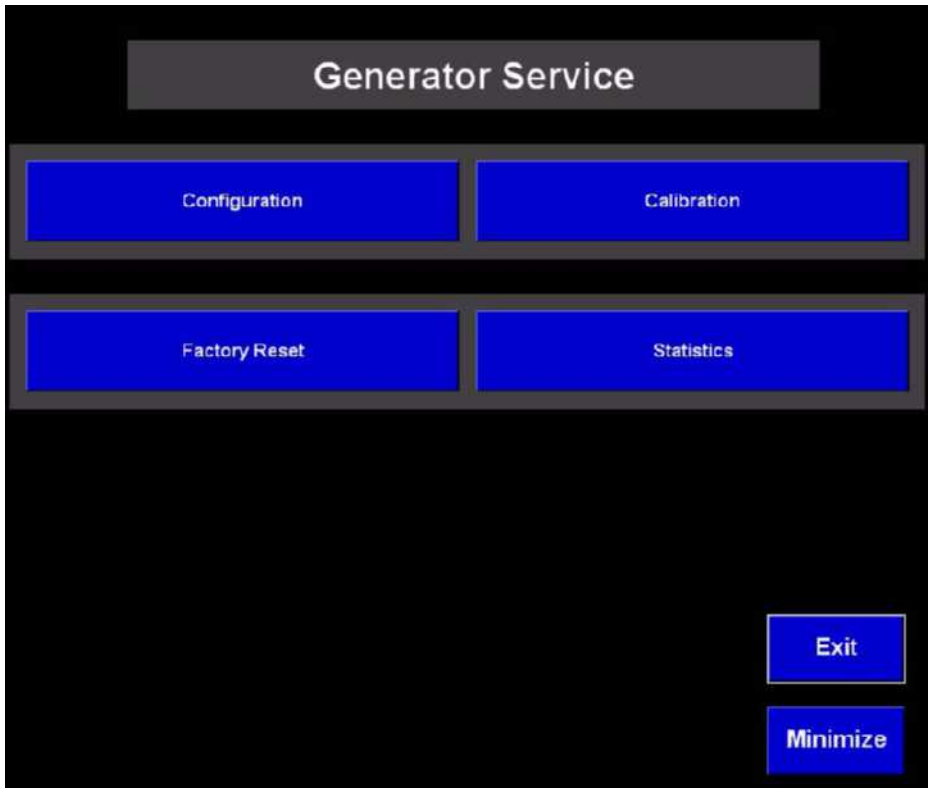


Figure B-3. Generator Service Menu

The Generator Service Menu offers the following selections:

- **Configuration** - The Configuration utility provides access to configuration settings, such as AEC type, rotor drive settings, tube type, etc.
- **Calibration** - The Calibration utility provides access to filament, mA, kVp and AEC calibrations (when equipped).
- **Factory Reset** - Accesses the Factory Reset function, which provides a list of resettable system calibration and configuration parameters including: Tube curves, AEC (AEC calibration values), History (Error Log), kV, mA, and filament calibration values.
- **Statistics** - Provides access to generator and tube usage data, and error and warning reports (refer to Chapter 5, SERVICE MAINTENANCE for more details).

Selecting the **Minimize** button reduces the Generator Service menu to a button (labelled "Service") visible next to the Generator Control Panel Overlay. Pressing the Service button re-opens the Generator Service menu.

FACTORY RESET

The Factory Reset Menu provides Calibrations and AEC Calibrations reset functions as well as the Backup Configuration utility. Factory Reset may be necessary following tube replacement or when troubleshooting abnormal system behavior.

Figure B-4. Factory Reset Menu

Factory Reset

The Calibrations Reset function resets the currently saved kV, mA, and filament calibration constants to factory default settings; the AEC Calibrations Reset function resets the currently saved AEC Optical Density and AEC kV calibration constants for all previously calibrated film screens to factory default settings. To perform factory reset, proceed as follows:

1. Press the **Reset** button corresponding with either "Calibrations" or "AEC Calibrations" shown in Figure 3-4. The Reset Calibrations Screen will display:

Note: The Reset Generator Calibrations pop-up screen is shown in the sample screen below. The Reset AEC calibrations pop-up screen (not shown) is similar in operation.

Figure B-5. Reset Calibrations Screen (Typical)

NOTE

Following a Factory Reset, the KV, filament, mA and AEC (if equipped) Calibration procedures, described in this chapter, must be performed.

2. Press **Yes** to continue with reset, press **No** to cancel reset. The system returns to the Factory Reset Menu (Figure 3-4).

Backup Configuration Utility

The Backup Configuration utility saves the current configuration settings and calibration data in a "backup file". This data can later be restored back to the generator following factory reset, thereby eliminating the need to re-calibrate the generator. However, re-verification of calibration is required.

To create a backup configuration file, press the **Save** button corresponding with "Backup Configuration" shown in Figure 3-4. The system overwrites existing backup data with current system data and updates the backup date and time fields appearing on the Factory Reset Menu.

GENERATOR CONFIGURATION

Press the **Configuration** button to access the generator configuration utility. The Load Configuration From menu displays:

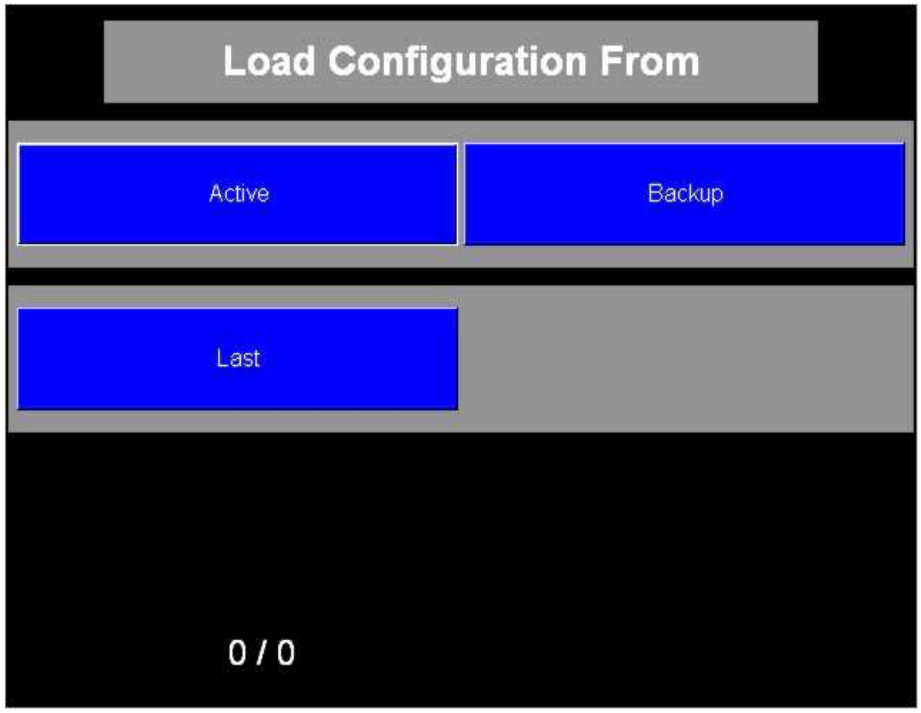


Figure B-6. Load Configuration From Menu

The Load Configuration From menu offers three choices:

- **Active** - Select to load the currently active configuration (This option should be selected under normal circumstances; only when a problem occurs with the system should the Backup or Last options be selected)
- **Backup** - Select to load the last backed up configuration. (Refer to Factory Reset description in this chapter for instructions on creating a backup file of the generator calibration data.)
- **Last** - Select to load the last automatically-saved generator configuration (Note: The configuration file is automatically backed up every time the Workstation Computer establishes a connection to the generator.)

It should be noted that changes made to any of the generator configuration parameters, as described in the following paragraphs, will not be saved until confirmation is made in the Activate Configuration screen shown below:

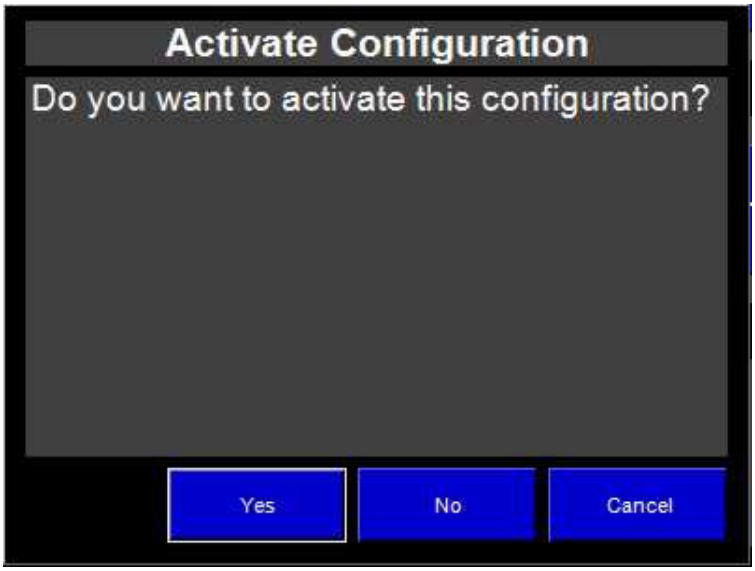


Figure B-7. Activate Configuration Screen

In the Load Configuration From menu, select **Active**. The Configuration Menu displays:

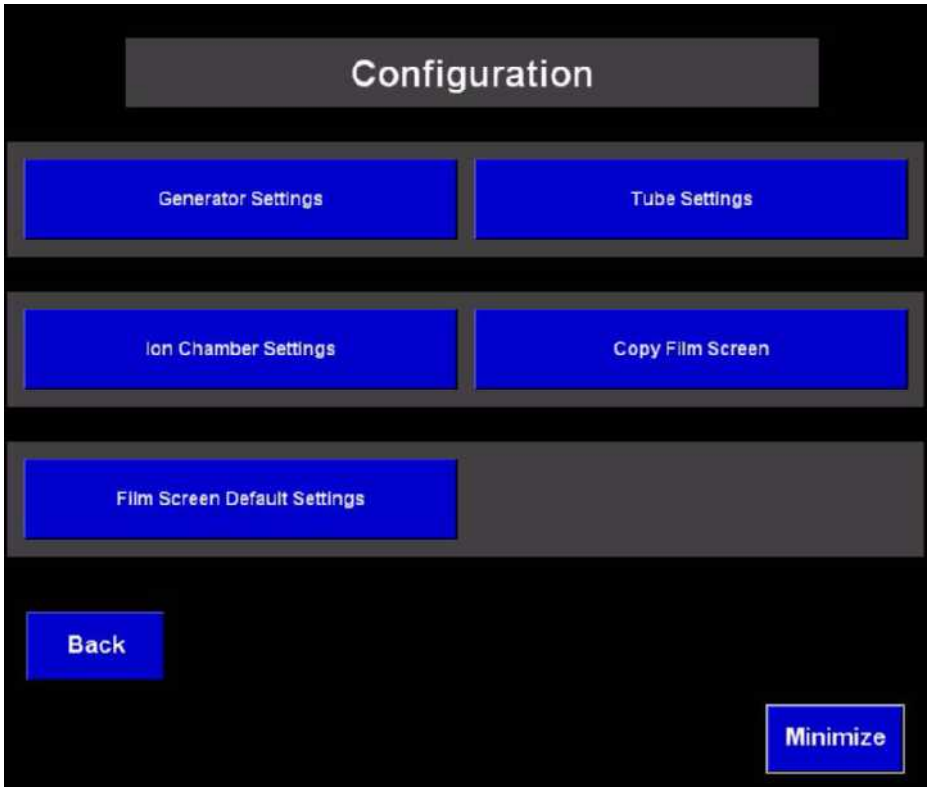


Figure B-8. Configuration Menu

The Configuration Menu provides access to the system's configuration settings. For proper operation of the generator, the settings must accurately reflect the actual configuration of both the generator and the components to which it is interfaced. Typically, these settings are made at the factory in accordance with sales order specifications. However, it is recommended that you review the current configuration settings for accuracy. The following briefly describes the various Configuration Menu selections:

- **Generator Settings**: Accesses the Generator Settings screen, which contains Derating, Timeout, AEC Board Type, and Backup mAs settings
- **Tube Settings**: Accesses the Tube Type Setting screen, for selection of x-ray tube model used with system
- **Ion Chamber Settings**: Accesses the Ion Chamber Configuration screen, which is used to configure each ion chamber interfaced with the system (two separate ion chambers, of either slope or level type, can be interfaced to the generator)
- **Copy Film Screen**: Accesses the Copy Film/Screen Menu. The Copy Film/Screen Menu is a utility that enables AEC calibration data to be

copied from one calibrated film/screen combination setting to another (for example, it is useful for copying "Wall 40" to "Table 40 " film/screen combination on systems configured with both a wall stand and table).

To change a configuration setting, press the button next to the configuration selection to be changed. The following paragraphs provide specific instructions for setting each of the available configuration selections.

Generator Settings

The Generator Settings Screen, shown below, displays the generator model, power output derating (presented as a percentage of total power output (kW) capacity), Timeout (sleep mode), AEC Board Type, Backup MAS, and Digital Receptor On/Off settings.

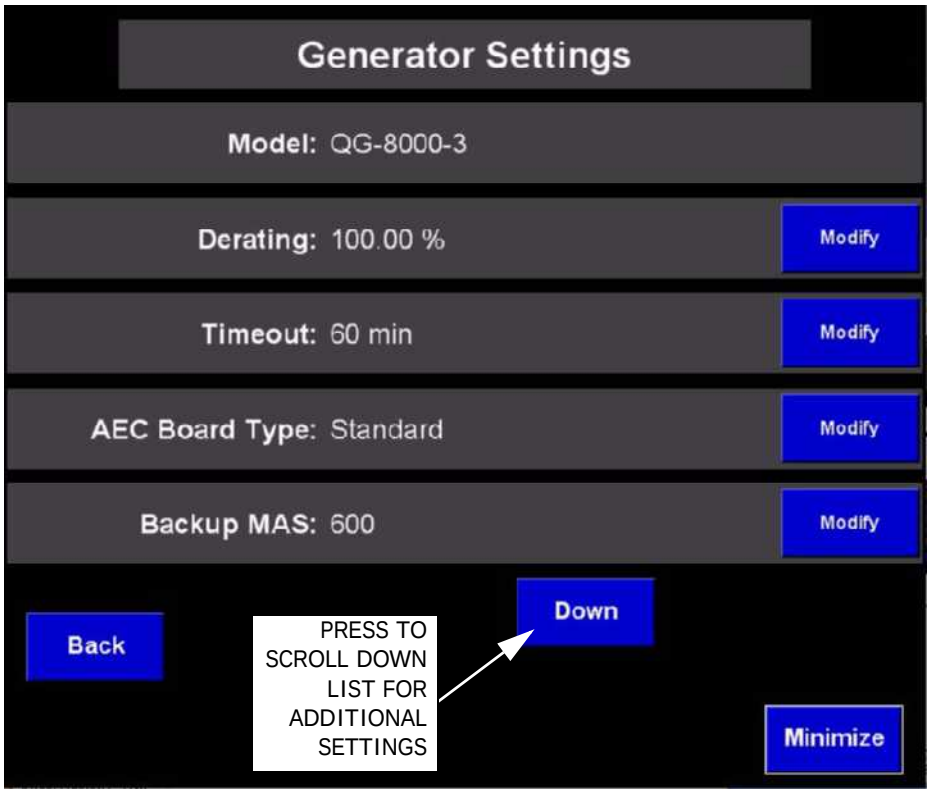


Figure B-9. Generator Settings Screen

1. **Derating** - The derating function is used to limit the output of the system to a percentage of the maximum energy capacity. To derate the energy output, press the **Modify** button adjacent to the **Derating** field to choose a derating percentage (choices are 80%, 85%, 90%, 95% or 100% [i.e., no derating]).

2. **Generator Timeout**: The "timeout" period selected represents the amount of delay time, after which if no user activity is detected, the system automatically enters Automatic Power Stand By mode. This mode is entered to help reduce power consumption while protecting system electronics. The timeout period is selectable in 30 minute increments between 0 minutes up to 180 minutes. If "Infinity" is selected, the generator will not timeout, however, the filament will turn off if one hour of inactivity.
3. **AEC Board Type**: Displays the optional AEC Board type
   a. Select "Standard" if generator is equipped with standard type AEC Board A11 (AY40-031S)
   b. Select "Universal" if generator is equipped with universal type AEC Board A11 (AY40-027S)
   c. Select "None" if generator is not equipped with optional AEC
4. **Backup MAS**: Displays the current system-wide backup mAs setting effective on all AEC exposures. The maximum back up mAs setting is 600; note that on certain model generators, such as the Stored Energy models, the maximum mAs capability of the generator is less than 600 mAs. Therefore, the backup mAs setting should not exceed the maximum MAS output of the generator. Refer to Chapter 1, SPECIFICATIONS for a list of the mAs ratings by model number.
5. **Digital Receptor**: Accesses the digital receptor "PREP HOLD" setting (On or Off). Setting the Prep Hold setting to **On** configures the generator to send a "Prep Hold" signal to the DR system (notifies the DR system that a Prep cycle has been initiated; the generator must receive a "Prep Hold Release" signal from the DR system to proceed with the Expose cycle). Setting the Prep Hold setting to **Off** configures the generator for "normal" operation (i.e., non-interrupted Prep cycle).
6. Press the **Back** button on the lower left side of the screen. The system returns to the Configuration Menu (see Figure 3-8).

Tube Settings

The Tube Settings Screen, shown below, displays the current tube model and rotor settings. Also provided are the Tube Derating (Tube%) and Heat Warning (Heat% Limit) settings. The tube model and rotor settings are preset at the factory and normally should not be changed, except after replacing the existing tube with a different type tube. *(Note: Consult Quantum Service Department before attempting to re-configure the generator with a tube type that is different than the factory-configured tube type.)*

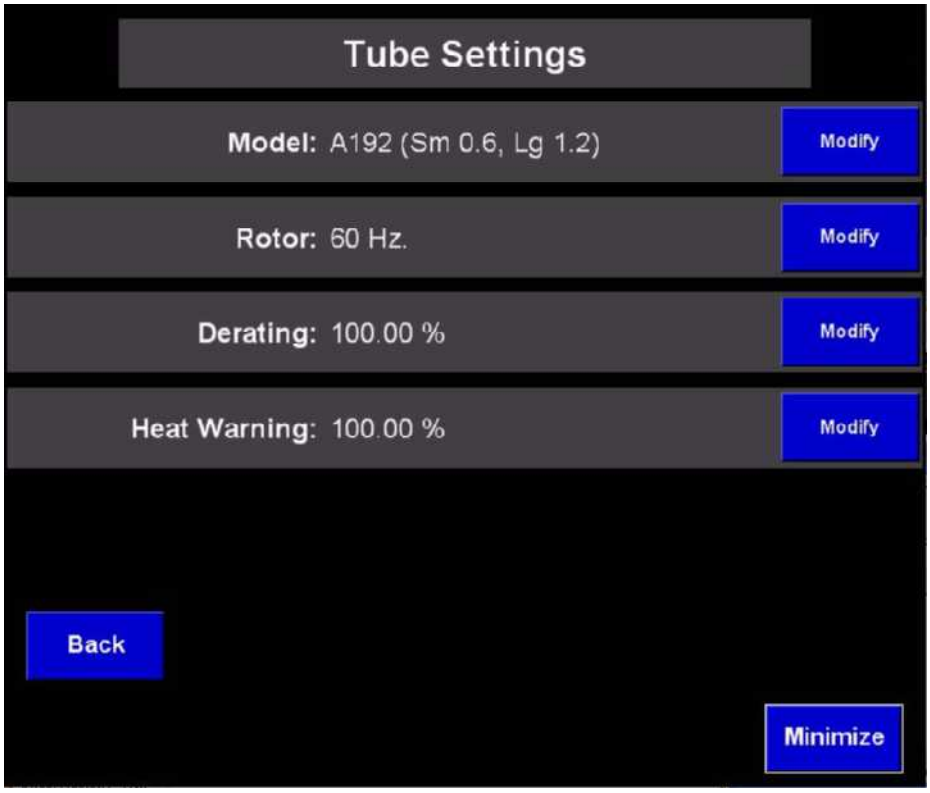


Figure B-10. Tube Settings Screen

1. To change the tube model setting, press the **Modify** button adjacent to the Model field. The Model sub-menu will display; find the correct tube model (use the **Next** button to display additional tube models), then select the button with the correct model number appearing on it.
2. To change the tube rotor setting, press the **Modify** button adjacent to the Rotor field. Scroll through the available rotor drive settings: 50 Hz (no high speed starter), 60 Hz (no high speed starter), AID external high-speed starter (AID HSS), or Quantum internal high-speed starter (QMI HSS).

NOTE: On systems equipped with high-speed starter option (HSS), tube "high-speed" mode will only be activated when selected exposure factors exceed the limits used for low-speed operation.

3. The Tube Derating setting provides derating of the tube's maximum mAs output in percentages of 80%, 85%, 90%, 95% or 100% (i.e., no derating). For example, if at a particular kV and mA the tube normally allows a 10 mAs exposure, then at 80% derating, the tube would permit only an 8 mAs exposure. Derating the tube can extend the life of the tube. Press the button adjacent to the **Derating** field to choose a derating percentage.
4. The Heat Warning (heat%) provides a heat protection function for the x-ray tube. For example, setting the Heat Warning for 80% will cause the generator to produce an audible alarm and a visual "Heat Alarm" indication on the OCP when the tube has reached 80% of its total heat unit capacity. The total tube heat unit capacity is dependant upon the tube type. The Heat Warning setting has an adjustment range of anywhere between 50% up to 100% in 10% increments. Note: At 100% setting, the heat alarm is effectively disabled. Press the button next to the Heat Warning field to select the percentage of the total tube heat capacity at which alarm activation will occur.
5. Press the **Back** button on the lower left side of the screen. The system returns to the Configuration Menu (see Figure 3-8).

Ion Chamber Configuration

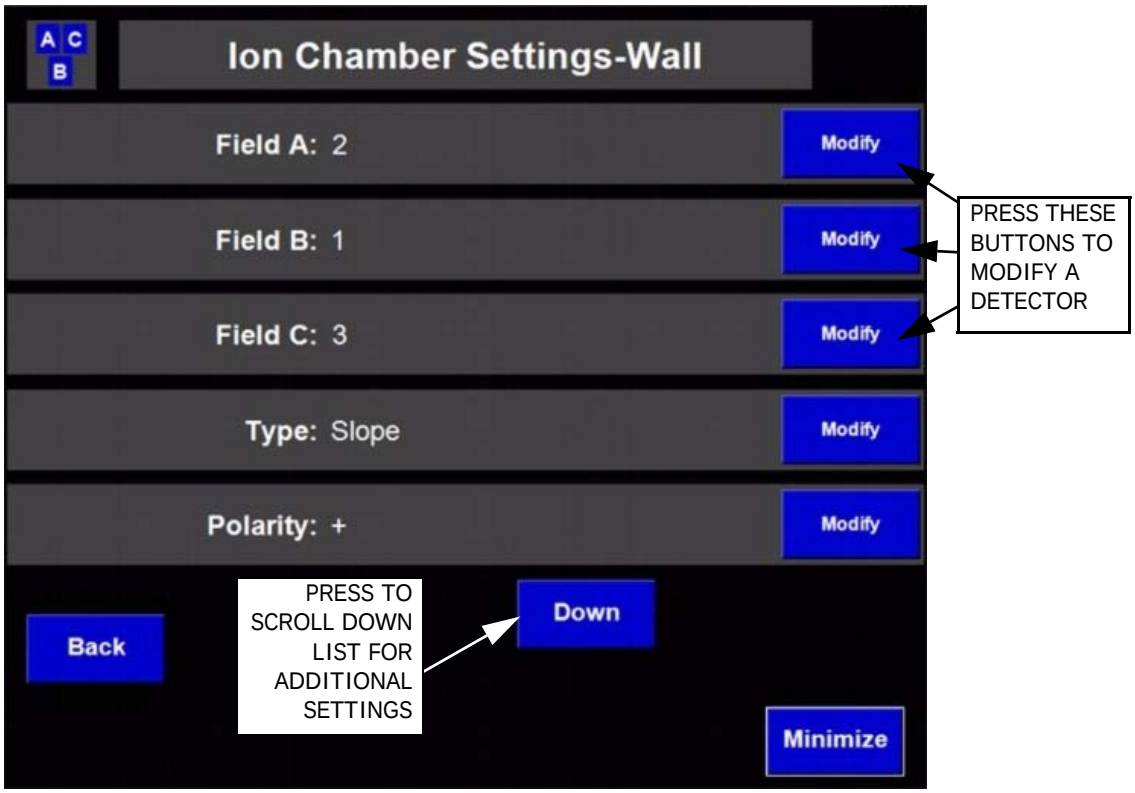
The Select Ion Chamber Menu, shown below, displays available ion chambers that can be interfaced to the HF Series X-ray generator. This screen also provides relay on/off settings for activating either the table and/or wall receptor when the receptor buttons on the OCP are pressed.

Note: On systems equipped with a "Standard" type AEC Board (AY40-031S), the "Wall 2" and "Aux" selections are not used. These choices are only effective if the generator is configured with "Universal" type AEC Board (AY40-027S).

Figure B-11. Select Ion Chamber Menu

1. Press the button corresponding with the ion chamber you want to configure: **Wall**, **Table**, **Wall 2**, or **Aux** (**Wall 2** and **Aux** only used on systems equipped with AEC Board A11, AY40-027S). Be sure that the selected ion chamber is properly interfaced to AEC Board A11 as described in Chapter 2, ASSEMBLY & INSTALLATION.

2. The system displays the ION CHAMBER Configuration Screen, as shown in the example below:



NOTE: AID ICX-153 or ICX-1153 RIGHT LOAD USES THIS CONFIGURATION. FOR AID ICX-153 or ICX-1153 LEFT LOAD, SET A=3 AND C=2.

Figure B-12. Ion Chamber Settings Screen

The Ion Chamber Settings Screen displays the assignment of ion chamber detectors (detector A, B, and C) with respect to the generator's ion chamber detector select signals (i.e., FIELD SELECT 1, FIELD SELECT 2 and FIELD SELECT 3) generated by AEC Control Board A11. That is, assigning "2" to Field "A" enables detector "2" when the UPPER LEFT chamber detector field is selected at the Operator Control Panel.

The Ion Chamber Settings Screen also provides settings that facilitate proper compatibility of the generator with ion chambers that operate differently. These include Ion Chamber Type (Slope/Level), Polarity (+/-), Output (Normal/Inverted), and Relay On/Off o settings.

3. Press the **Modify** button adjacent to the ion chamber detector (Field A, Field B or Field C) and choose the desired detector setting (1, 2, 3 or Off).

4. The "Type" setting determines if the ion chamber connected to the selected receptor AEC output is of the "slope/ramp" (Slope) or a DC Level (Level) type. This setting is ignored unless the "Universal AEC" selection is chosen. The "Standard AEC" board should always be set to **Slope**.

5. The "Polarity" setting (**+** or **-**) should correspond with the polarity of the ion chamber on the selected receptor port (i.e., a (+) positive logic [active high] or (-) negative logic [active low] model). The positive logic model presents a DC voltage or ramp ranging from 0 to some positive voltage to indicate exposure value. The negative logic model presents a DC voltage or ramp ranging from 0 to a negative voltage. This setting is ignored unless the "Universal AEC" selection is chosen. The "Standard AEC" board is always **+**.

6. The "Output" setting determines the sense of the signals that select the individual field for the chamber. If "Output" is set to **Normal**, the idle (non-PREP/EXPOSE) state of the individual field selection is "1" and the state during PREP/EXPOSE is "0" if the field is selected (called "Low Active"). If "Output" is set to **Inverted** the idle (non-PREP/EXPOSE) state of the field selection is "0" and the state during PREP/EXPOSE is "1" if the field is selected (called "High Active"). This setting is ignored unless the "Universal AEC" selection is chosen. The "Standard AEC" board is should always be set to **Normal**.

7. The "Wall Relay" setting controls whether or not the "Wall Relay" on the Universal AEC Board A11 AY40-027S is energized. Similarly, the "Table Relay" setting controls whether or not the "Table Relay" on the Universal AEC Board A11 AY40-027S is energized. These settings provide +28 VDC output for operation of a Siemens bucky. If this field is set to **On**, the relay is asserted when:

    - The WALL or TABLE receptor button that selects this receptor is depressed on the OCP or
    - When a pre-programmed (APR) technique requests this receptor

    The wall or table relay will remain energized until a receptor with "Wall Relay Off" or "Table Relay Off", respectively, is selected. Depending on the configuration of the generator, set the receptor relays as indicated in Table 3-2 or 3-3.

8. Press the **Back** button on the lower left side of the screen. The system returns to the Configuration Menu (see Figure 3-8).

IMPORTANT: The AID ICX-153 or ICX-1153 ion chamber, which is the default chamber type shipped with standard AEC type generators, requires that detector "A" = 2, "B" = 1, and "C" = 3. The factory default orientation of the ion chamber mounting in the bucky is with the front side toward the tube. However, it may be necessary to mount the chamber with the back side forward (e.g., for left side loading wall stands). In this case, in the Ion Chamber Settings screen, simply switch assignment of cham-

ber detector A to "3" and detector C to "2". No wiring modifications are necessary.

Table B-1. Ion Chamber Settings for Generator with Standard AEC (AEC Board AY40-031S)

	Standard AEC Systems	
Setting	**Wall Ion Chamber Settings**	**Table Ion Chamber Settings**
Polarity	+	+
Wall Relay	Off	Off
Table Relay	Off	Off
Invert	No	No
Slope/Lvl	Slope	Slope

Table B-2. Ion Chamber Settings for Generator with Universal AEC Option (AEC Board AY40-027S)

	Universal AEC Systems					
	Ion Chamber Type					
	Siemens (Level)		AID (Slope) Tomo Systems		AID (Slope) Non-Tomo Systems	
Setting	**Wall Ion Chamber Settings**	**Table Ion Chamber Settings**	**Wall Ion Chamber Settings**	**Table Ion Chamber Settings**	**Wall Ion Chamber Settings**	**Table Ion Chamber Settings**
Polarity	+	+	+	+	+	+
Wall Relay	On	Off	On	Off	On	Off
Table Relay	Off	On	Off	On	Off	On
Invert	Yes	Yes	No	No	No	No
Slope/Lvl	Level	Level	Slope	Slope	Slope	Slope

Table 3-2 shows the ion chamber and receptor settings for the generator when equipped with standard AEC (i.e., Standard AEC Board A11 (AY40-031S) is installed). Table 3-3 shows the ion chamber and receptor settings for the generator when equipped with universal AEC (i.e., Universal AEC Board A11 (AY40-027S) is installed).

Film / Screen Default Settings

The Film/Screen Default Settings Screen (see below) is used to configure the default film/screens associated with the various image receptors used with the generator. These settings apply only during AEC mode exposures. *Note that the film/screen(s) selected for use must be calibrated according to the AEC Calibration procedures described in this chapter, otherwise, AEC operation will likely not operate optimally.*

The generator has been pre-configured with nine different film/screen combination selections designated "Wall40", "Wall72", "Table40", "100 Speed", "200 Speed", "800 Speed", "Canon", "Agfa", and "Digital" to choose from.

The Film/Screen Default Settings screen, shown below, displays the current film/screen combination settings. To change the default film/screen settings, proceed as follows

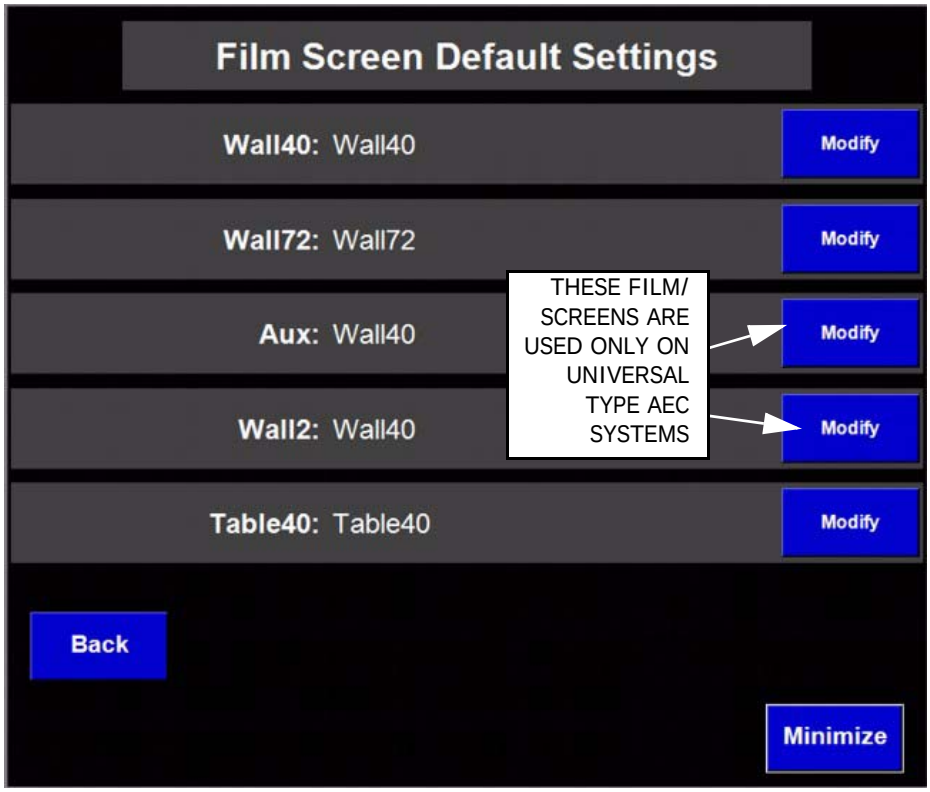


Figure B-13. Film Screen Default Settings Screen

1. **Wall40** setting: Press the **MODIFY** button adjacent to the **Wall40** field. The Select Film Screen sub-menu will display; press the button with the appropriate film/screen name appearing on it (use the **Next** button to

display additional choices). The chosen film/screen combination is now the default film/screen combination used when the "WALL 40" image receptor is selected for exposures during AEC exposure mode.

2. **Wall72** setting: Press the **MODIFY** button adjacent to the **Wall72** field. The Select Film Screen sub-menu will display; press the button with the appropriate film/screen name appearing on it (use the **Next** button to display additional choices). The chosen film/screen combination is now the default film/screen combination used when the "WALL 72" image receptor is selected for exposures during AEC exposure mode.
3. **Table40** setting: Press the **MODIFY** button adjacent to the **Table40** field. The Select Film Screen sub-menu will display; press the button with the appropriate film/screen name appearing on it (use the **Next** button to display additional choices). The chosen film/screen combination is now the default film/screen combination used when the "TABLE" image receptor is selected for exposures during AEC exposure mode.
4. **Aux** setting (enabled only on generators equipped with "Universal" type AEC [i.e., AEC Board A11 AY40-027S is installed]): Press the **MODIFY** button adjacent to the **Aux** field. The Select Film Screen sub-menu will display; press the button with the appropriate film/screen name appearing on it (use the **Next** button to display additional choices). The chosen film/screen combination is now the default film/screen combination used when the "AUX" image receptor is selected for exposures during AEC exposure mode.
5. **Wall2** setting (enabled only on generators equipped with "Universal" type AEC [i.e., AEC Board A11 AY40-027S is installed]): Press the **MODIFY** button adjacent to the **Wall2** field. The Select Film Screen sub-menu will display; press the button with the appropriate film/screen name appearing on it (use the **Next** button to display additional choices). The chosen film/screen combination is now the default film/screen combination used when the "WALL2" image receptor is selected for exposures during AEC exposure mode.
6. Press the **Back** button on the lower left side of the screen. The system returns to the Configuration Menu (see Figure 3-8).

NOTE

The "default" film/screen combination settings automatically link specific calibrated film/screen combinations used in non-APR and APR exposures using AEC. However, the operator may choose any available calibrated film/screen combination using the Film/Screen selection buttons provided in the AEC and APR mode screens.

Copy Film Screen Utility

The Copy Film Screen utility enables stored AEC calibration data (kV curves, AEC reference data) to be copied from a calibrated film/screen combination to another film/screen combination in order to reduce overall calibration time.

For example, if calibration was completed for the wall stand 40 inch SID film/screen combination (i.e., Wall40), its calibration data can be copied to the uncalibrated table 40 inch SID film/screen combination (i.e., Table40) film/screen using this utility. Although all required AEC Calibration procedures must still be performed, this will set the calibration values for the Table40 film/screen combination to fairly accurate settings, thereby reducing the number of exposures required for calibration. The Copy Film/Screen utility is most beneficial when the film screen combination being copied to has the same cassette screen, film speed, ion chamber and grid as the film/screen combination it is being copied from. Nevertheless, calibration time is likely to be reduced even if one or more of these elements differ. Proceed as follows:

1. On the Configuration Menu, press **Copy Film Screen** button (see Figure 3-8). The Selected Calibrated Film Screen menu appears:

Figure B-14. Select Calibrated Film Screen Menu

2. Select a previously calibrated Film/Screen combination to copy calibration data from (use the **Next** button to display additional choices).

3. The Select Destination Film Screen menu appears:

Figure B-15. Select Destination Film Screen Menu

CAUTION! Before proceeding, verify the "from" and "to" film screen copy selections are correct. Selecting Copy Film Screen as directed in the next step will cause calibration data for the film screen being copied "to" to be overwritten with the calibration data of the "from" film/screen.

4. Select the film/screen combination to copy the calibration data to (use the **Next** button to display additional choices). A copy confirmation pop-up will appear. To continue with copying, select **Yes**; to cancel without copying select **No**.

5. The system returns to the Configuration Menu (see Figure 3-8). If Yes was selected, all AEC calibration data has been copied from the previously calibrated film/screen combination to the destination film/screen combination. If No was selected, the operation was aborted without copying.

6. Press the **Back** button on the lower left side of the Configuration screen. The system returns to the Configuration Menu (see Figure 3-8).

GENERATOR CALIBRATION

CAUTION! Before calibrating unit, perform warm-up procedures recommended by tube manufacturer or the warm-up procedure described in Chapter 3 of the Operator's Manual.

WARNING! The following calibration procedures involve taking x-ray exposures. All personnel should be behind protective barriers during exposure. X-rays can be dangerous unless proper precautions and procedures are adhered to.

To access the generator calibration functions, press the button next to the **Calibration** field in the Service Options Menu (see Figure 3-3). The Calibration menu displays, shown below:

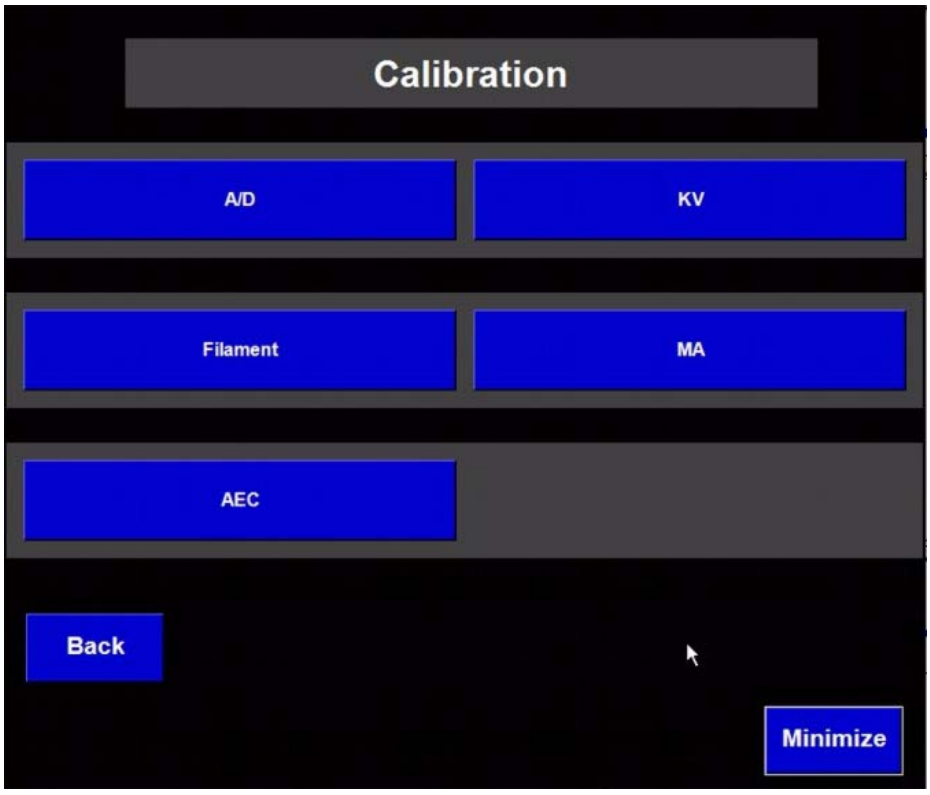


Figure B-16. Calibration Menu

The Calibration menu provides access to the system's various calibration functions. The generator was pre-calibrated at the factory, however, the system will need to be re-calibrated to assure proper operation, verify compliance and set

AEC optical density (on systems equipped with AEC option). These procedures should be performed in the order presented in this chapter. The following is a brief description of each of the Calibration Menu selections:

- **A/D:** Accesses the analog-to-digital (A-D) converters calibration function
- **KV**: Accesses KV calibration function
- **Filament**: Accesses tube filament offset calibration function
- **MA**: Accesses mA calibration function
- **AEC**: Accesses the AEC optical density and AEC kVp calibration functions (active on systems equipped with AEC option only). Note that all of the AEC Calibrations must be performed for each table and/or film/screen combination used with the x-ray system. Selection of each film/screen type used with the system is explained in "CONFIGURATION SETTINGS" paragraph described previously in this chapter.
- **Back**: Returns to the Generator Service Menu. This function is also provided in each of the above calibration screens, from which you are returned to the main Calibration Menu

The paragraphs that follow describe the procedures for performing each of the above calibration functions. Following initial system installation, these procedures should be performed in the order presented in this chapter.

General Calibration Procedure Notes

The following notes apply in general to all calibration procedures, including AEC calibration procedures. Please review these notes prior to performing calibration.

- Press the **Next** button to advance to the next calibration procedure.
- Press the **Back** button to return to the previous calibration procedure.
- Each calibration screen displays the correct KV, MA, time and thickness (in CM) value required for performing a particular calibration procedural step. However, always ensure the correct values are set prior to performing each procedural step.

A/D Calibration

The A/D (analog/digital converter) calibration utility is used to calibrate, against a traceable calibrated voltage measurement instrument (such as a DMM), various essential supply voltages utilized by the x-ray generator. After A/D calibration has been performed, the A/D calibration utility may then be used as a diagnostic tool allowing the technician to "read out" these voltage measurements without having to remove the cover from the generator cabinet and without connecting a meter.

Table B-3 shows the various voltage levels (with tolerances) that can be calibrated using this utility, and it provides the location of the test point at which a calibrated voltmeter must be connected for measuring the actual voltage level:

Table B-3. A/D Calibration Voltages

Voltage Level	Calibration Accuracy	Test Point Measurement Location
Cathode	±8 VDC	+/- bus bars on Capacitor Bank next to Power Module A19 (left side looking into generator cabinet)
Anode	±8 VDC	+/- bus bars on Capacitor Bank next to Power Module A18 (right side looking into generator cabinet)
+5VDC	±0.1 VDC	TP1 on Logic Board AY40-006S
+15VDC	±0.2 VDC	TP3 on KVP Control Board AY40-003S
-15VDC	±0.2 VDC	TP5 on KVP Control Board AY40-003S
Regulated +24	±0.3 VDC	TP8 on Power Supply Board AY40-005T
Unreg. +24V	±0.3 VDC	Terminal TB2-1 on Interface Board AY40-023T (or AY40-034T)

WARNING! The following procedure requires that power be applied to the generator. Extreme care must be exercised to ensure the safety of service or other personnel in the area.

The following procedure calibrates the generator to verify accurate system measurement of the above operating voltages. The same procedure applies to any of the voltage levels available for selection. Voltage measurement accuracy is verified using your pre-calibrated voltmeter (traceable to NIST standard) as the benchmark. Once calibrated, the generator's CPU continuously monitors these internal voltages and will terminate or not allow exposure if specified tolerances are exceeded. Proceed as follows:

1. In the Calibration Menu, press **AD** button (see Figure B-16). The AD Calibration Menu appears:

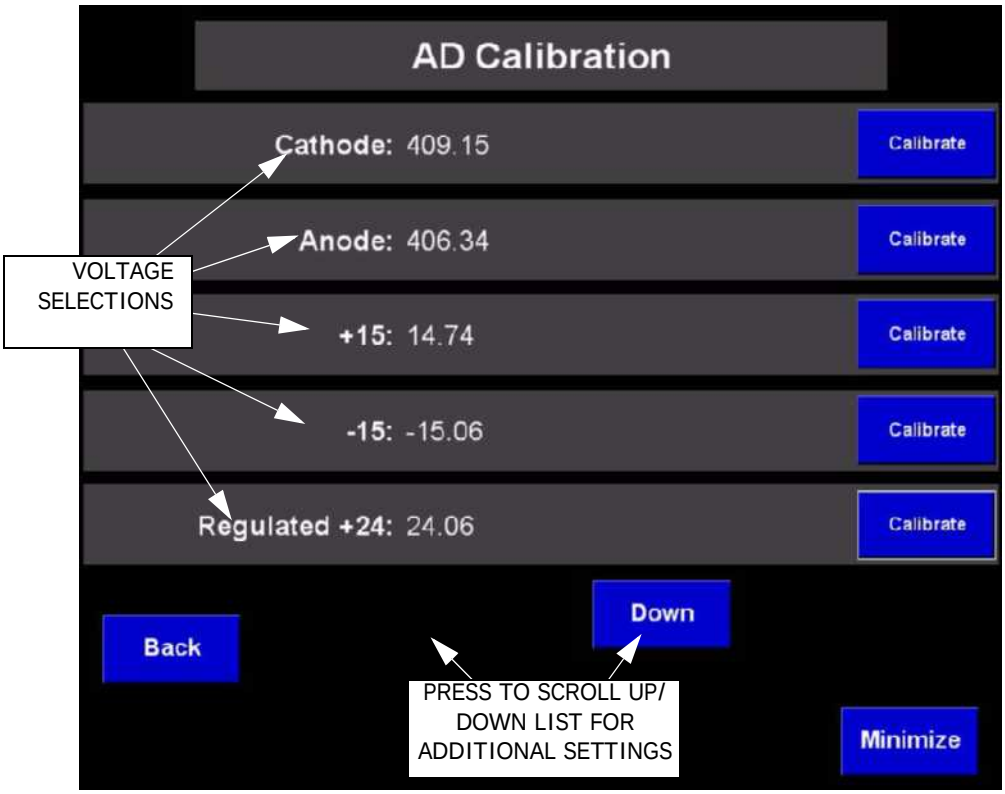


Figure B-17. AD Calibration Menu

2. Refer to Table B-3 and connect a voltmeter to the test point corresponding with the voltage level selected for calibration.
3. Select a voltage level to calibrate by pressing its corresponding **Calibrate** button (choices are Cathode (400V), Anode (400V), +15 VDC, -15 VDC, Regulated +24 VDC, Unregulated +24 VDC, and +5 VDC). For this example, "Cathode" is selected.

4. A keypad will display enabling input of the actual (measured) voltage level, such as the sample Cathode voltage input screen shown below:

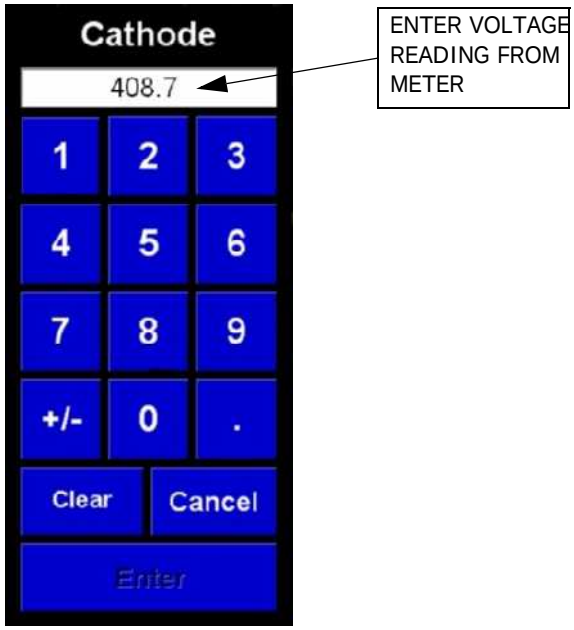


Figure B-18. Sample AD Voltage Input Screen (Cathode is shown)

5. On the voltmeter, observe the measured voltage value. Ideally, the value appearing in the AD Voltage Input Screen (below "Cathode") will match the reading on the voltmeter. If not, enter the measured value using the keypad.
6. Press **Enter** button to save the calibration entry.
7. Repeat above steps for each of the other AD voltage levels.
8. Press the **Back** button on the lower left side of the AD Calibration screen. The system returns to the Calibration Menu (see Figure 3-16).

kV Calibration

This procedure calibrates the generator to verify accurate system measurement of peak tube potential (kVp). The generator's ability to measure peak tube potential accurately is verified using a pre-calibrated kVp meter (Dynalyzer or equivalent) as a benchmark. Proceed as follows:

1. In the Calibration Menu, press **KV** button (see Figure B-16). The KV Calibration screen appears:

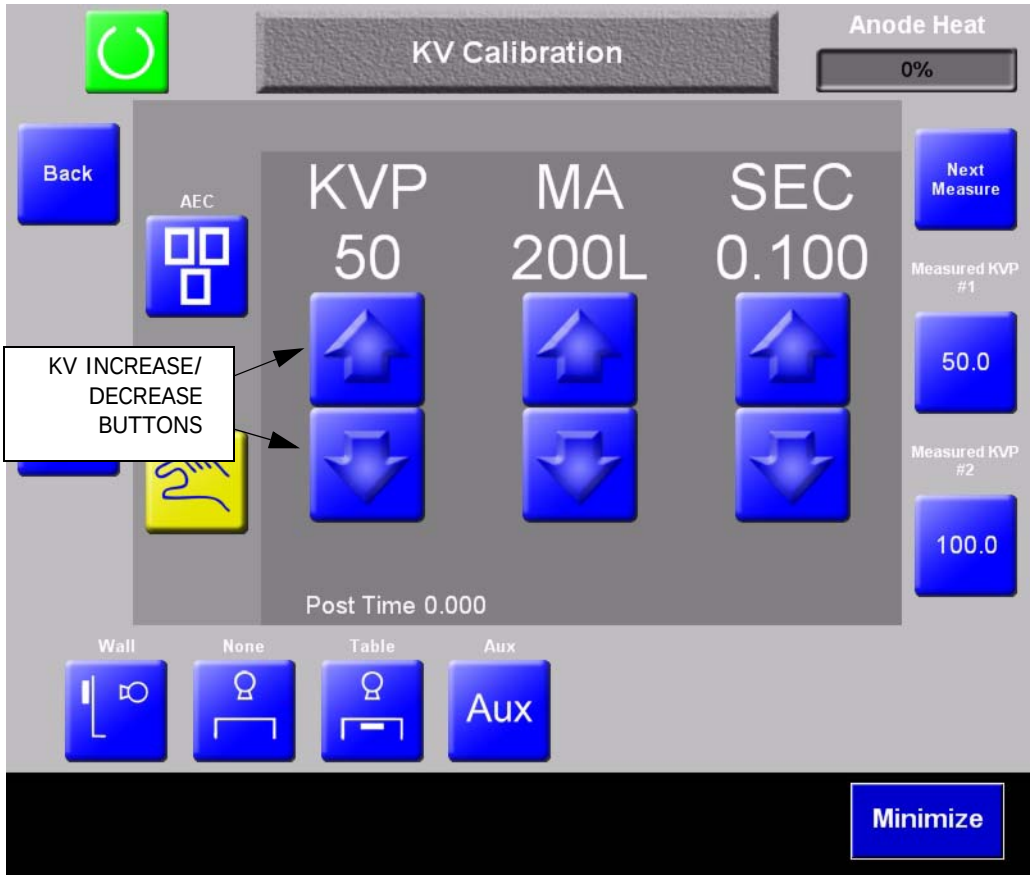


Figure B-19. KV Calibration Screen

WARNING! To avoid injury to personnel, ensure that system power is removed prior to making and removing any electrical connections.

2. Connect a kVp bleeder tank in series between X-ray tube and the generator's H.V. Transformer (A17), or use a non-invasive kVp meter.
3. Verify 50 KVP appears in the KV Calibration Screen and "Next Measure" appears on the top right button as shown in Figure B-19.

4. Take an exposure at the setting indicated on the KV Calibration Screen (i.e., 50 kVp, 200L mA, 100 mS).
5. On the kVp meter, observe the measured kV value. (Ideally, this value should be 50 kVp.)
6. If not 50 kVp, press the 50 kVp adjustment button (located directly below "Measured KVP#1" label). Find the measured KVP value in the scrollable list, select it then press **Enter**. The values appearing in the list are in one-tenth increments.
7. Press **Next Measure** button to proceed to 100 kV calibration setting.
8. Verify 100 KVP appears on the KV Calibration Screen and "Save Calibration" now appears on the top right button.
9. Take an exposure at the setting indicated on the KV Calibration Screen (i.e., 100 kVp, 200L mA, 100 mS).
10. On the kVp meter, observe the measured kV value. (Ideally, this value should be 100 kVp.)
11. If not 100 kVp, press the 100 kVp adjustment button (located directly below "Measured KVP#2" label). Find the measured KVP value in the scrollable list, select it then press **Enter**.
12. Press **Save Calibration** button. The KV Calibration Screen (First Measure) should be displayed.
13. Repeat KV calibration for both 50 and 100 kVp until indicated and measured kVp values agree to within 4% tolerance.
14. To proceed to filament calibration, press the **Next** button.

Filament Offset Calibration

This procedure establishes the filament current offset and gain corrections. Filament current measurement accuracy is verified using a pre-calibrated Dynalyzer (or equivalent), non-invasive kV meter, or mAs meter as a bench-mark. Ensure precision of the measurement instrument is sufficient enough to assure generator accuracy requirements can be met. The Filament Offset Calibration procedure may be performed using an oscilloscope, however, it is not the preferred method. Using this method, the objective is to achieve the "flattest" possible large and small filament waveforms, with no spikes or peaks as shown in Figure B-20 below.

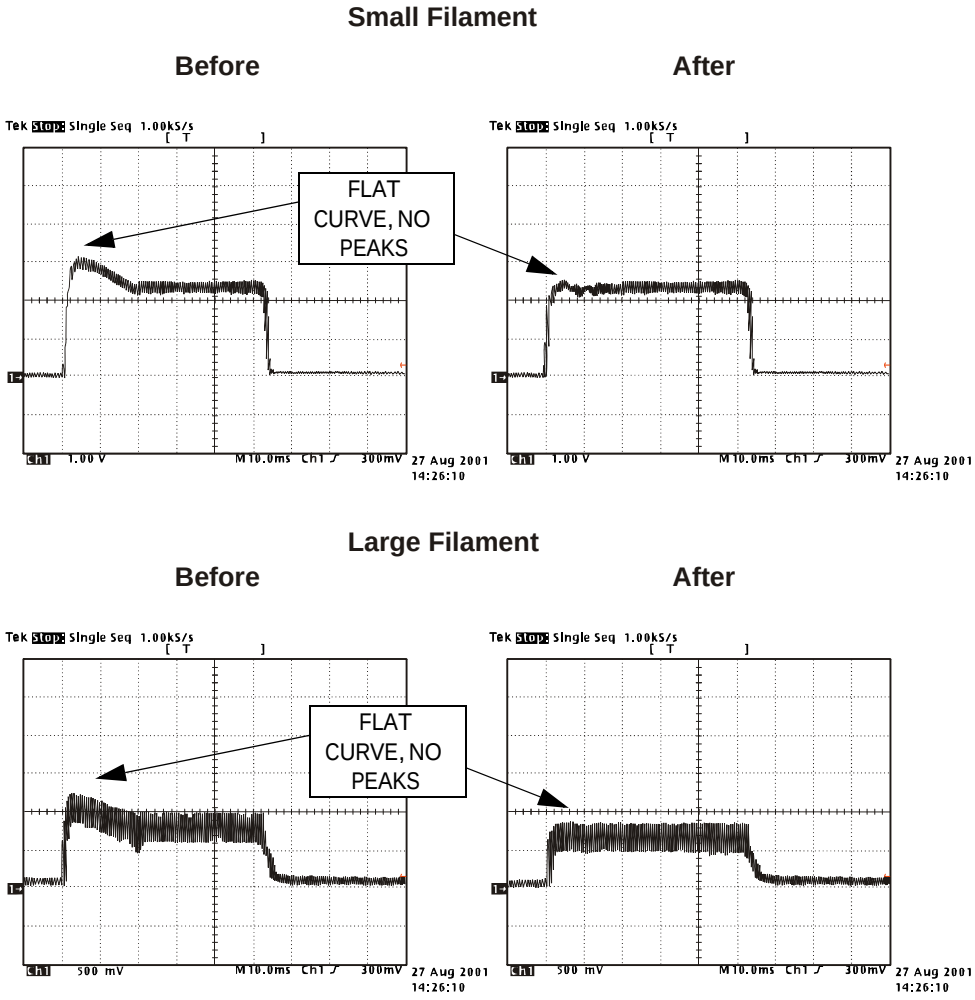


Figure B-20. Filament Offset Current Measurement (Using an Oscilloscope)

Access the Filament Calibration Menu (shown below) and proceed as follows:

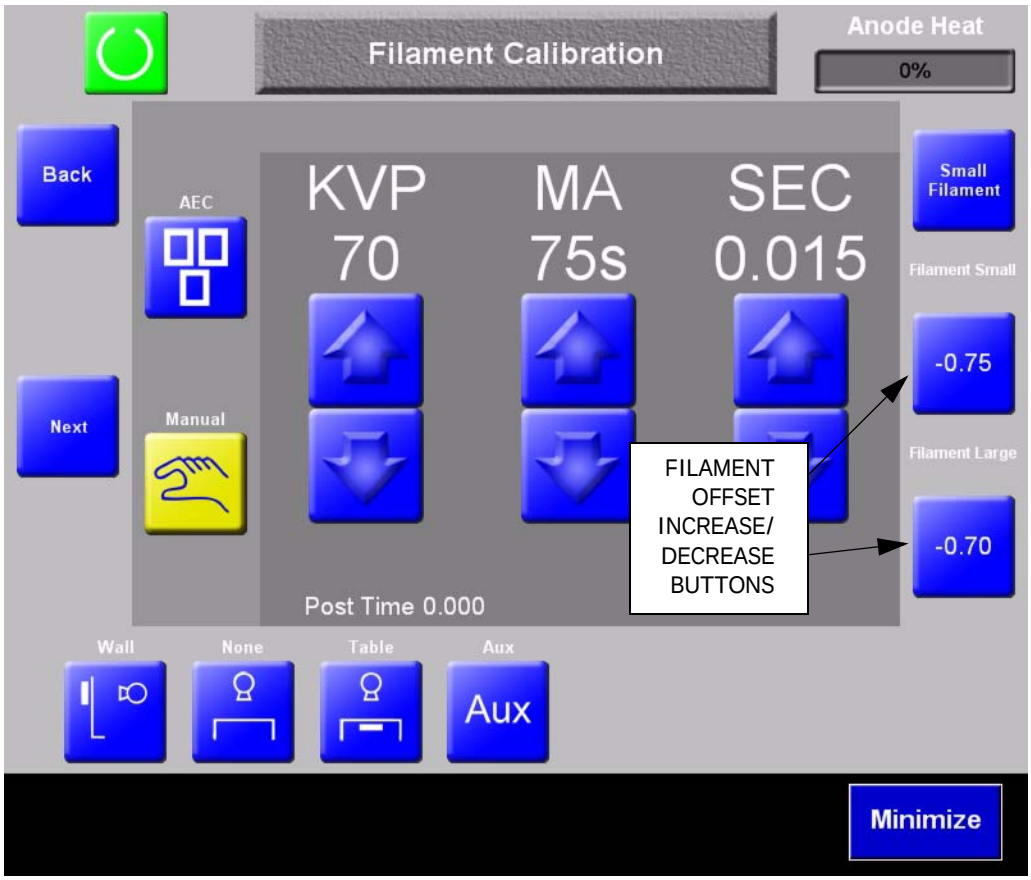


Figure B-21. Filament Calibration Screen

WARNING! To avoid injury to personnel, ensure system power is removed prior to making and removing any electrical connections.

1. If using a Dynalyzer, a kVp bleeder tank should be connected in series between tube and High-Voltage (H.V.) Transformer A17.

2. If using a mAs meter, remove two (2) green/yellow wires marked "MAS METER", connected to A17P1-9 and A17P1-10, from the ground stud on top of the H.V. Transformer (see Figure B-22). Connect the mAs meter in series between removed wires. (*Important: These wires must be re-connected when finished calibration.*)

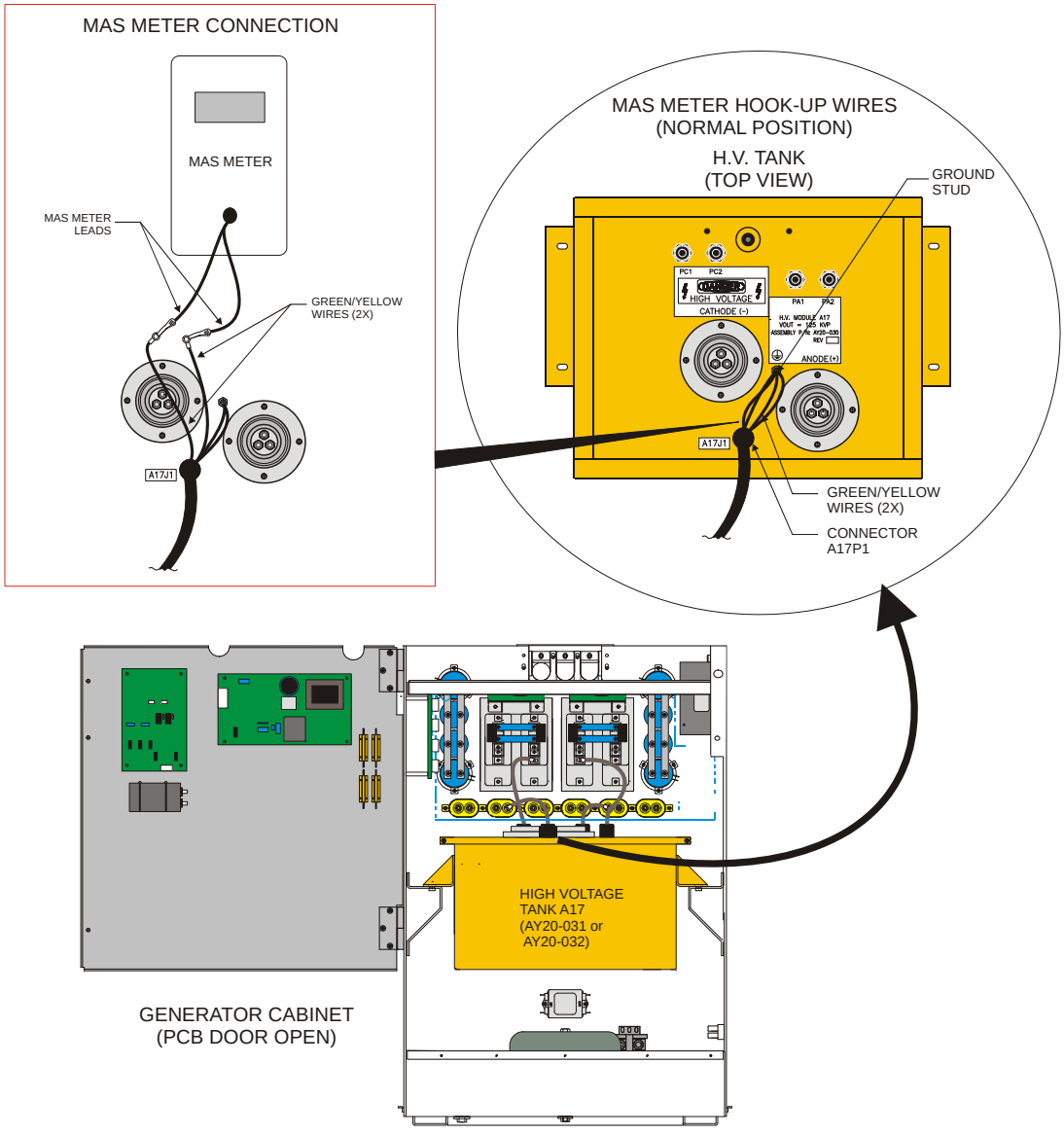


Figure B-22. MAS Meter Connection

3. If using an oscilloscope, connect the scope leads between test point TP7 on KVP Control Board A2 (AY40-003S) and ground. Set scope for 1.0 volt/division, and 50 ms/division time base. This will give a 100 mA/volt equivalent for mA measurement as shown in the sample waveforms in Figure B-20.
4. Take an exposure at the setting indicated on the Filament Calibration Screen (i.e., 70 kVp, 75s mA, 15 msec). *If using an oscilloscope, set time to 50 msec*.
5. On the Dynalyzer Digital Display or mAs meter, observe the measured mA value. (Ideally, this value should be 75 mA or 1.125 mAs.) If using an oscilloscope, observe the small filament current pulse waveform for "flatness" (see Figure B-20).
6. If not 75 mA, or if waveform is not flat, press the small filament offset value button (located directly below "Filament Small" label). The filament offset amperage values (in hundredth increments as shown in the sample screen below) range from +10.00 down to -10.00, with 0.00 equating to no offset applied to the tube's default filament curve. To increase mA, raise the filament offset value; to decrease mA, lower the filament offset value.

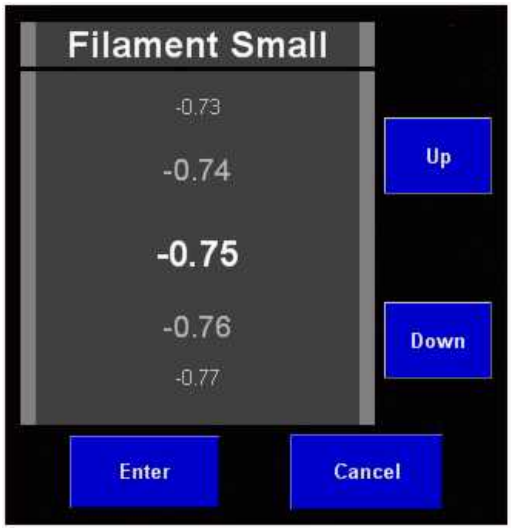


Figure B-23. Sample Filament Offset Values Screen

7. Re-take exposure at same settings and adjust small filament offset value if necessary. Repeat this step until measured mA equals 75 or when waveform is sufficiently flat. Press the **Small Filament** button to proceed.

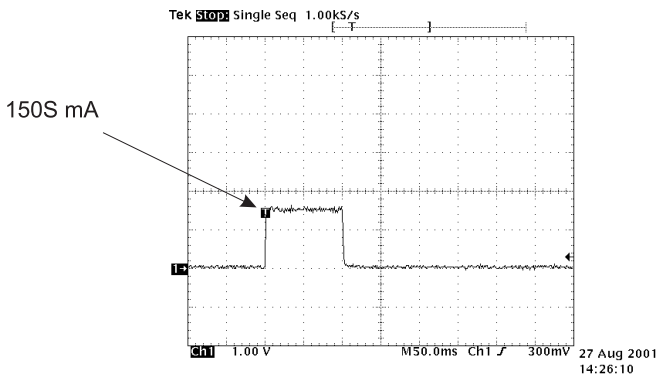
8. The large filament calibration screen is displayed. Note the "Filament Small" button is now yellow to indicate small filament calibration is complete.
9. Take an exposure at the setting indicated on the Filament Calibration Screen (i.e., 70 kVp, 300L mA, 15 msec). *If using an oscilloscope, set time to 50 msec*.
10. On the Dynalyzer Digital Display or mAs meter, observe the measured current value. (Ideally, this value should be 300 mA or 4.5 mAs.)
11. If not 300 mA, or if waveform is not flat, press the large filament offset value button (located directly below "Filament Large" label). To increase mA, raise the filament offset value; to decrease mA, lower the filament offset value.
12. Re-take exposure at same settings and adjust large filament offset value if necessary. Repeat this step until measured mA is 300 or when waveform is sufficiently flat. If so, filament calibration is complete.
13. To proceed to mA calibration, press the **Next** button.

Note: An error message appears if the filament current is set too low, which indicates the filament offset value for the filament being calibrated is set too low or high. If this occurs, increase or decrease the filament current.

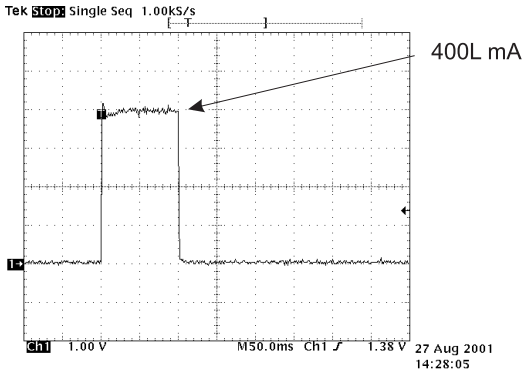
MA Calibration

This procedure calibrates the generator to verify accurate system measurement of tube current (mA). Current measurement accuracy is verified using a pre-calibrated mAs meter (Dynalyzer or equivalent) as a benchmark. Ensure precision of the measurement instrument is sufficient enough to assure generator accuracy requirements can be met.

An oscilloscope may be used for mA measurement, however, it likely will not be precise enough to assure generator mA accuracy. To use an oscilloscope for mA measurement, connect scope leads between test point TP7 on KVP Control Board A2 (AY40-003S1) and ground. Set scope for 1.0 volt/division, and 50 ms/division time base. This will give a 100 mA/volt equivalent for mA measurement (see Figure B-23a for sample mA measurements using scope).



Example 1 - 60 kVp, 150S mA, 100 ms



Example 2 - 60 kVp, 400L mA, 100 ms

Figure B-23a. MA Measurement Using an Oscilloscope

Proceed as follows:

WARNING! To avoid injury to personnel, ensure that system power is removed prior to making and removing any electrical connections.

1. If not already done so, a kVp bleeder tank should be connected in series between tube and High-Voltage (H.V.) Transformer A17. If using a mAs meter, connect the mAs meter between pins A17P1-9 and A17P1-10 on H.V. Transformer A17. This connection is made by removing the two green/yellow wires connecting A17P1-9 and A17P1-10 to the ground stud on top of the H.V. Transformer (see Figure B-22) and connecting the removed wires to the mAs meter. (Note: The MAS meter should remain connected throughout calibration. *These wires must be re-connected when finished calibration*.)

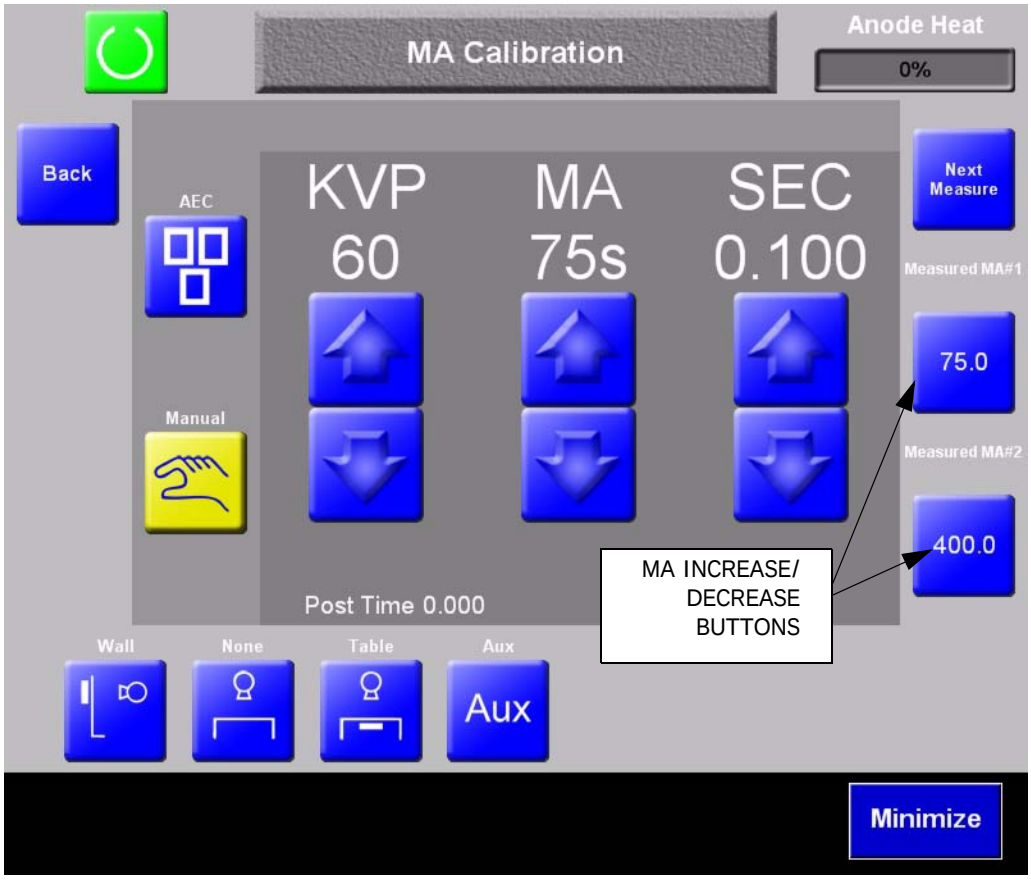


Figure B-24. MA Calibration Screen

2. Verify 75s mA appears in the MA Calibration Screen and "Next Measure" appears on the top right button as shown in Figure B-24.
3. Take an exposure at the setting indicated in the MA Calibration Screen (i.e., 60 kVp, 75s mA, 100 mS).
4. On the Dynalyzer Digital Display or mAs meter, observe the measured mA value. (Ideally, this value should be 75 or 7.5 mAs.)
5. If not 75 mA, press the 75 mA adjustment button (located directly below "Measured MA#1" label). Find the measured mA value in the scrollable list, select it then press **Enter**. The values appearing in the list are in one-tenth increments. Repeat mA calibration for 75s until indicated and measured mA values agree to within 5%+1 mA.
6. Press **Next Measure** button to proceed to 400L mA calibration setting.
7. Verify 400L mA appears in the MA Calibration Screen and "Save Calibration" now appears on the top right button.

8. Take an exposure at the setting indicated on the MA Calibration Screen (i.e., 60 kVp, 400L mA, 100.0 mS).
9. On the Dynalyzer Digital Display or on mAs meter, observe the measured mA value. (Ideally, this value should be 400 mA or 40 mAs.)
10. If not 400 mA, press the 400 mA adjustment (located directly below "Measured MA#2" label). Find the measured mA value in the scrollable list, select it then press **Enter**. The values appearing in the list are in one-tenth increments.
11. Press **Save Calibration** button.
12. Repeat mA calibration for 400L mA until indicated and measured mA values agree to within 5%+1 mA.

    Note: The Power Supply Board's +48 VDC output may require adjusting (using potentiometer A6R17) up to +55 VDC (max.) in cases where long-length high tension cables are used and/or a heavy duty x-ray tube is installed. This can be determined by measuring the mA output (using a Dynalyzer or mAs meter) of an exposure taken at 40 to 50 kVp and the highest mA station available. The mA measured should be the same as the indicated mA (within specified tolerance). If mA output is too low, increase the +48 VDC voltage output as required, but do not exceed +55 VDC.

13. To return to the main calibration screen, press the **Back** button. If the system is equipped with QG-AEC option, perform AEC calibration. Otherwise, calibration is complete.

⚠ **CAUTION! If using a mAs meter, re-connect the green/yellow wire marked "MAS METER" to the ground stud on top of the H.V. Transformer (see Figure B-22).**

Appendix B Calibration (DiRex System)

AEC CALIBRATION

CAUTION! Before calibrating unit, perform warm-up procedures recommended by tube manufacturer or the warm-up procedure described in Chapter 3 of the Operator's Manual.

IMPORTANT! Before performing each AEC calibration procedure, verify the correct Film/Screen is displayed on the calibration screen (shown in top left field).

In most DR or CR Film Plate systems, the entire imaging area of the digital receptor or CR Film Plate must be covered with acrylic in order to obtain accurate "S" or "REX" values used for the procedures that follow. Refer to the calibration instructions provided with digital or CR system for specific "S" or "REX" values required for AEC calibration.

IMPORTANT! Always place a CR film plate in the cassette holder when taking any measurements or when calibrating, even if the calibration step does not require a film to be exposed.

The following procedures must be performed to ensure successful AEC calibration of the HF Series X-ray generator when configured as part of the DiRex System (i.e., integration to Agfa Computed Radiography (CR) Film Plate). Table B-4 shows a summarized presentation of the AEC calibration procedure. An AEC calibration Worksheet is provided in Table B-5 for recording calibration data.

Table B-4. CR System AEC Calibration Procedure Sequence

FILM/SCREENS TO BE CALIBRATED	REQUIRED AEC CALIBRATION PROCEDURES/ SPECIAL INSTRUCTIONS
WALL STAND 72" SID FILM/SCREEN (SLOWEST SPEED, LARGEST SID)	1. Perform "Ion Chamber Balancing" procedure. 2. Perform "AEC MAS Balance" procedure for wall stand ion chamber. 3. Perform "AEC Optical Density (OD) Calibration": a. Set desired "base" optical density b. Set "AEC Ref" to 1200. c. Adjust ion chamber's MASTER GAIN potentiometer until base density is achieved in acquired images. 4. Perform "AEC KV Calibration".

Table B-4. CR System AEC Calibration Procedure Sequence

FILM/SCREENS TO BE CALIBRATED	REQUIRED AEC CALIBRATION PROCEDURES/ SPECIAL INSTRUCTIONS
WALL STAND 40" SID FILM/SCREEN	1. Copy "Wall 72" film/screen to "Wall 40". 2. Perform "AEC Optical Density (OD) Calibration", however, **DO NOT** re-adjust the ion chamber MASTER GAIN potentiometer. Adjust "AEC Ref" to obtain desired (set) density. 3. Perform "AEC KV Calibration".
TABLE 40" SID FILM/ SCREEN	1. If system includes a wall stand, copy "Wall 40" film/screen to "Table 40". 2. Perform "Ion Chamber Balancing" procedure for table ion chamber. 3. Perform "AEC Optical Density (OD) Calibration": a. Set desired "base" optical density b. Set "AEC Ref" to 1200. c. Adjust ion chamber's MASTER GAIN potentiometer until base density is achieved in acquired images. 4. Perform "AEC KV Calibration".

Table B-5. AEC Calibration Worksheet

Film/Screen Combination:	Table 40	Wall 40	Wall 72
AEC OD CALIBRATION			
Setting:	**50 kVp, 200L mA, 5 cm**		
Optical Density:			
Sensitivity (REX) Value			
AEC Ref.			
AEC KV CALIBRATION			
Setting:	**Step 1 - 50 kVp, 200L mA, 5 cm**		
Optical Density:			
Sensitivity (REX) Value			
Setting:	**Step 2 - 60 kVp, 200L mA, 10 cm**		
Optical Density:			
Sensitivity (REX) Value			
Setting:	**Step 3 - 80 kVp, 200L mA, 15 cm**		
Optical Density:			
Sensitivity (REX) Value			
Setting:	**Step 4 - 100 kVp, 200L mA, 20 cm**		
Optical Density:			
Sensitivity (REX) Value			
Setting:	**Step 5 - 110 kVp, 200L mA, 25 cm**		
Optical Density:			
Sensitivity (REX) Value			
Setting:	**Step 6 - 120 kVp, 200L mA, 30 cm**		
Optical Density:			
Sensitivity (REX) Value			
Setting:	***Step 7 - 130 kVp, 200L mA, 30 cm**		
Optical Density:			
Sensitivity (REX) Value			
Setting:	***Step 8 - 140 kVp, 200L mA, 30 cm**		
Optical Density:			
Sensitivity (REX) Value			

* Only required on 150 kVp systems

Ion Chamber Balancing (Three-field Chambers)

On systems using a three-field ion chamber, the chamber detectors must be balanced prior to performing AEC calibration (refer to the ion chamber manufacturer's instruction manual). When balanced, the mAs will be approximately the same (±5%) for exposures taken using any of the three chambers, or with two or more chambers selected simultaneously. This procedure must be performed on each ion chamber used in the system (for example, both table and wall ion chambers when equipped with two). Before proceeding, check that the ion chamber detectors have been correctly configured so when the chamber select buttons on the operator control panel are pressed, the appropriate ion chamber detector is enabled. If not, refer to "Table/Wall Ion Chamber Configuration Screens" procedure described previously in this chapter and re-configure. Proceed as follows:

1. If not already done so, a kVp bleeder tank should be connected in series between tube and High-Voltage (H.V.) Transformer A17. If using a mAs meter, connect the mAs meter between pins A17P1-9 and A17P1-10 on H.V. Transformer A17.
2. Access Generator Settings Screen (see Figure B-9). Make a note of the Backup MAS setting, then change the Backup MAS to "40".
3. Press the Manual/AEC Mode button on the operator control panel and select AEC mode.
4. Using a lead sheet, cover the UPPER RIGHT and CENTER ion chamber detectors.
5. Place 20 CM acrylic over UPPER LEFT ion chamber detector.
6. Set operator control panel for 100 KV, 200L MA, select the UPPER LEFT ion chamber detector and take an exposure. Note the measured mAs reading.
7. Repeat above steps with the CENTER ion chamber detector selected and UPPER LEFT and UPPER RIGHT detectors covered with lead. The measured mAs reading should be within 5% of the mAs reading noted in the previous step. If not, adjust the CENTER detector gain potentiometer located on the ion chamber amplifier (refer to ion chamber manufacturer's documentation for details), then re-take exposure and verify it is within tolerance. Repeat as necessary.

NOTE: If the system is equipped with "universal" type AEC (i.e., AEC Board A11 is part number AY40-027S), and the ion chamber is "level" type (i.e., Siemens), adjust the appropriate detector gain potentiometer on AY40-027S in accordance with the table below:

Table B-6. Universal AEC Board A11 Detector Gain Adjustment Potentiometers (Siemens Ion Chamber Only)

ION CHAMBER	DETECTOR	AEC BOARD A11 (AY40-027S) POTENTIOMETER
TABLE	1	R61
TABLE	2	R63
TABLE	3	R66
WALL#1	1	R54
WALL#1	2	R55
WALL#1	3	R56
WALL#2	1	R53
WALL#2	2	R58
WALL#2	3	R57

8. Repeat above steps with UPPER RIGHT ion chamber detector selected and UPPER LEFT and UPPER CENTER detectors covered with lead. The measured mAs reading should be within 5% of the mAs reading noted in the previous step. If not, adjust the UPPER RIGHT detector gain potentiometer, re-take exposure and verify it is within tolerance. Repeat as necessary.
9. Access the Generator Settings Screen and reset Backup MAS to original setting noted previously.

AEC MAS Balance Verification

The generator AEC mAs balance was pre-calibrated at the factory. However, verification of AEC mAs balance assures AEC calibration accuracy. When balanced, the mAs at the specified exposures will be approximately the same (±6%). This procedure only needs to be performed once prior to AEC calibration of the film/screen combination(s) used with the system. Proceed as follows:

1. If not already done so, connect a kVp bleeder tank in series between tube and High-Voltage (H.V.) Transformer A17. If using a mAs meter, connect the mAs meter between pins A17P1-9 and A17P1-10 on H.V. Transformer A17. This connection is made by removing the two green/yellow wires connecting A17P1-9 and A17P1-10 to the ground stud on top of the H.V. Transformer (see Figure B-22) and connecting the removed wires to the mAs meter. (Note: These wires must be re-connected when finished calibration.)
2. Place 20 cm of acrylic in the X-ray beam. (Where practical, adjust acrylic thickness to obtain approximately 100 millisecond exposures.)
3. If calibrating a" level" type ion chamber, ensure all three ion chamber detectors are selected.
4. Press the Manual/AEC Mode button on the operator control panel and select enter AEC mode.
5. Set the operator control panel for 110 kVp (100 kVp if calibrating a "level" type (Siemens) ion chamber - requires AY40-027S AEC board), 75S mA and take an exposure.
6. On the Dynalyzer Digital Display or mAs meter, note the measured mAs value.
7. Set the operator control panel for 110 kVp (100 kVp if calibrating a "level" type (Siemens) ion chamber - requires AY40-027S AEC board) and the highest available mA station. Take an exposure.
8. On the Dynalyzer Digital Display or mAs meter, note the measured mAs value.
9. The mAs values noted must be within ±5%. If not, adjustment of the dV/dt potentiometer on AEC Board A11 is necessary:
    - If the generator is equipped with "standard" type AEC (i.e., AEC Board A11 is part number AY40-031S), adjust potentiometer A11R12 to increase or decrease the mAs value.

- If the generator is equipped with "universal" type AEC (i.e., AEC Board A11 is part number AY40-027S), and the ion chamber is "level" type (i.e., Siemens), adjust potentiometer A11R82 to increase or decrease the mAs value.
- If the generator is equipped with "universal" type AEC (i.e., AEC Board A11 is part number AY40-027S), and the ion chamber is "slope" type (i.e., AID), adjust potentiometer A11R87 to increase or decrease the mAs value.

10. Re-take exposure at the above settings. Repeat until the two measured values are within range.
11. Take an exposure at 110 kVp (100 kVp if calibrating a "level" type (Siemens) ion chamber), 75S mA, 10 cm. Verify mAs value is within ±5% of previous measurements.
12. Take an exposure at 110 kVp (100 kVp if calibrating a "level" type (Siemens) ion chamber), a mid-range mA value, 10 cm. Verify mAs value is within ±5% of previous measurements.

CAUTION! If using a mAs meter, re-connect the green/yellow wire marked "MAS METER" to the ground stud on top of the H.V. Transformer (see Figure B-22).

Film Screen Selection

Calibration of film/screen combinations should be performed in the following sequence, assuming a typical radiographic system having one ion chamber in the wall stand (72" and 40" SID), and a second ion chamber used in the radiographic table (40" SID).

If the system is using a wall stand and 200 and 400 speed films, calibrate the Wall 72" film screen combination using 200 speed film first, followed by Wall 72" using 400 speed film.

If the system only has a table receptor, perform all AEC calibrations (i.e., ion chamber balance, AEC MAS balance, AEC optical density, and AEC KVP procedures).

IMPORTANT NOTE: Typically, the AEC calibration parameters for each of the various receptors used with the generator are quite similar. Therefore, the HF Series generator's calibration data "Copy Film Screen" function can be used to copy the calibration parameters from one receptor (i.e., a calibrated receptor) to the other receptors. For example, after completing AEC calibration of 72" Wall film/screen, the Copy Film Screen function can be used to copy the 72" film/screen calibration data to 40" Wall film/screen.

After copying AEC data, the only further AEC calibration usually required for the 40" film/screen is performing AEC OD Calibration to set the "AEC Ref" value. Similarly, the 40" Wall film/screen calibration data can be copied to the 40" Table, however, the table ion chamber's MASTER GAIN potentiometer must be adjusted as required. Be sure to verify the AEC films for each SID/receptor meet applicable regulatory agency requirements. If required, further optical density accuracy can be attained by performing the "AEC KV Calibration" procedure.

1. From the Calibration Menu (see Figure 3-16), press the **AEC** button. The Select Film Screen Menu is displayed:

Figure B-25. Select Film Screen Menu

2. Select the film/screen combination to calibrate (use the **Next** button to display additional choices).

The HF Series X-ray generator provides for calibration of up to nine different film/screen combinations. Note that each image receptor used with the generator is configurable for use with a particular film/screen combination using the Film Screen Default Settings Screen described previously in the Configuration section of this chapter (see Figure 3-13). For example, when the operator presses the WALL button on the operator control panel and selects the WALL 72" receptor, the system can be programmed to use the "Wall 72"" designated film/screen combination (i.e., the film/screen type used with the wall stand at 72" SID). On the same system, a different film/screen type, designated as "Table 40" for example, could be configured for use with the TABLE receptor.

Typically, on a system using a wall stand and radiographic table, three separate film/screen combinations are used:

- Wall 72" - Used when the operator selects wall receptor at 72 inch source-to-image distance (SID)

- Wall 40" - Used when the operator selects wall receptor at 40 inch source-to-image distance (SID)
- Table 40" - Used when the operator selects table receptor at 40 inch source-to-image distance (SID)

On generators equipped with "Universal" type AEC (AEC Board A11 AY40-027S installed), two additional image receptors and their corresponding film/screens (default names are "WALL2" and "AUX") may also be configured similar to those listed above. It is important to note that each different type of film/screen combination used with the receptors be calibrated in accordance with the AEC Calibration procedures described in this chapter.

Throughout AEC calibration, the film/screen being calibrated is displayed on every AEC calibration screen at the end of the top field. Note that the sample AEC calibration screens show "Wall40" in the instructions that follow; this is because the "Wall40" film screen was selected. The screens will actually reflect whichever of the available nine film screens you choose.

When calibrating AEC using a wall stand mounted receptor, ensure that the x-ray beam is perpendicular to image receptor and that the correct ion chamber detector(s) is selected.

IMPORTANT! Use the same configuration of bucky, grid, ion chamber and film cassette/screen that will be used with the "Film/Screen" being calibrated.

The AEC Calibration Menu

WARNING! The following calibration procedures involve taking x-ray exposures. All personnel should be behind the protective barriers. X-rays can be dangerous unless proper precautions and procedures are adhered to.

Following selection of a film/screen to calibrate, the AEC Calibration Menu displays:

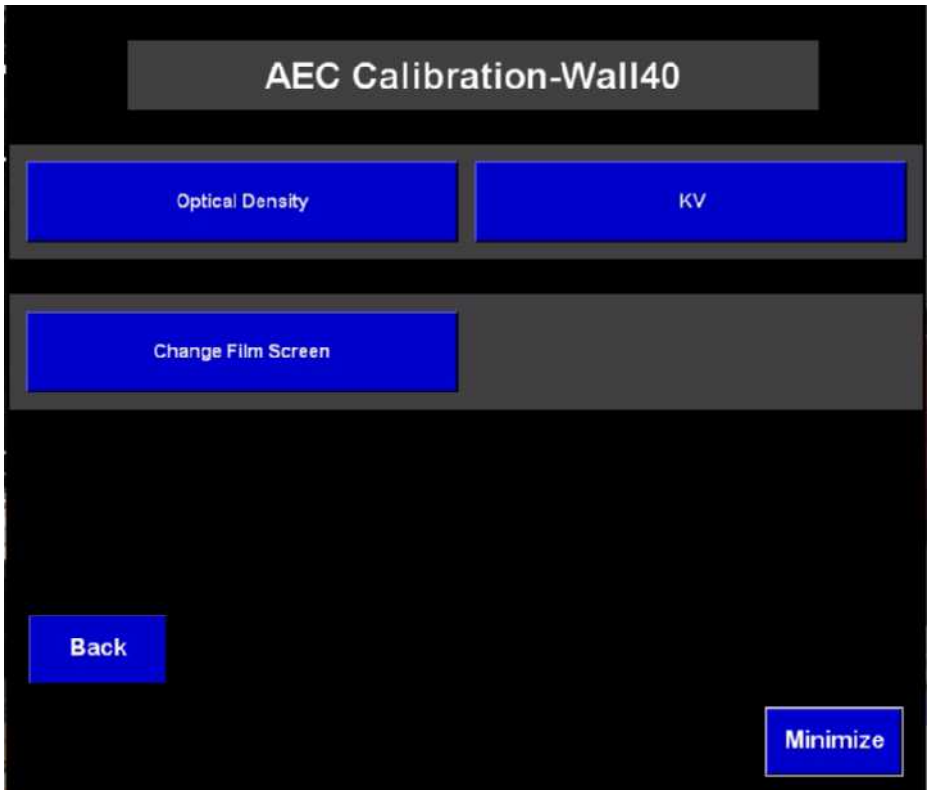


Figure B-26. AEC Calibration Menu

NOTE: In normal AEC mode, select the appropriate receptor (Wall 72", Wall 40", or Table 40") prior to selection of a film/screen combination for AEC calibration.

The AEC Calibration menu provides access to the system's various AEC calibration functions, briefly described as follows:

- **Optical Density** - Calibrates the optical density for the currently selected film/screen and ion chamber combination

- **KV** - Calibrates the tube voltage settings used in conjunction with the currently selected film/screen and ion chamber combination
- **Change Film Screen** - Accesses the Select Film Screen Menu (see Figure 3-23) for selection of a film screen to calibrate.
- **Back** - Returns to the Calibration Menu (see Figure 3-16)

Optical Density Calibration

This procedure calibrates the generator's AEC system to a user-selectable, dose calculation (density) setting (e.g., 2.1). This setting determines the basic "brightness" quality of images acquired in AEC mode using the CR system. This is accomplished by comparing the CR Film Plate's actual Logarithmic Median (LGM) value with the Target Level selected using the AEC Optical Density Calibration screen (see Figure B-27).

When calibrating the first film/screen combination, which should be the slowest speed film and/or the largest SID receptor, set the "AEC Base" value to 2000, and adjust the MASTER GAIN potentiometer on the ion chamber until the desired target density is obtained. Proceed as follows:

AEC Optical Density Calibration

1. In the AEC Calibration Menu, press **Optical Density** button (see Figure 3-26). The AEC Optical Density Calibration screen appears:

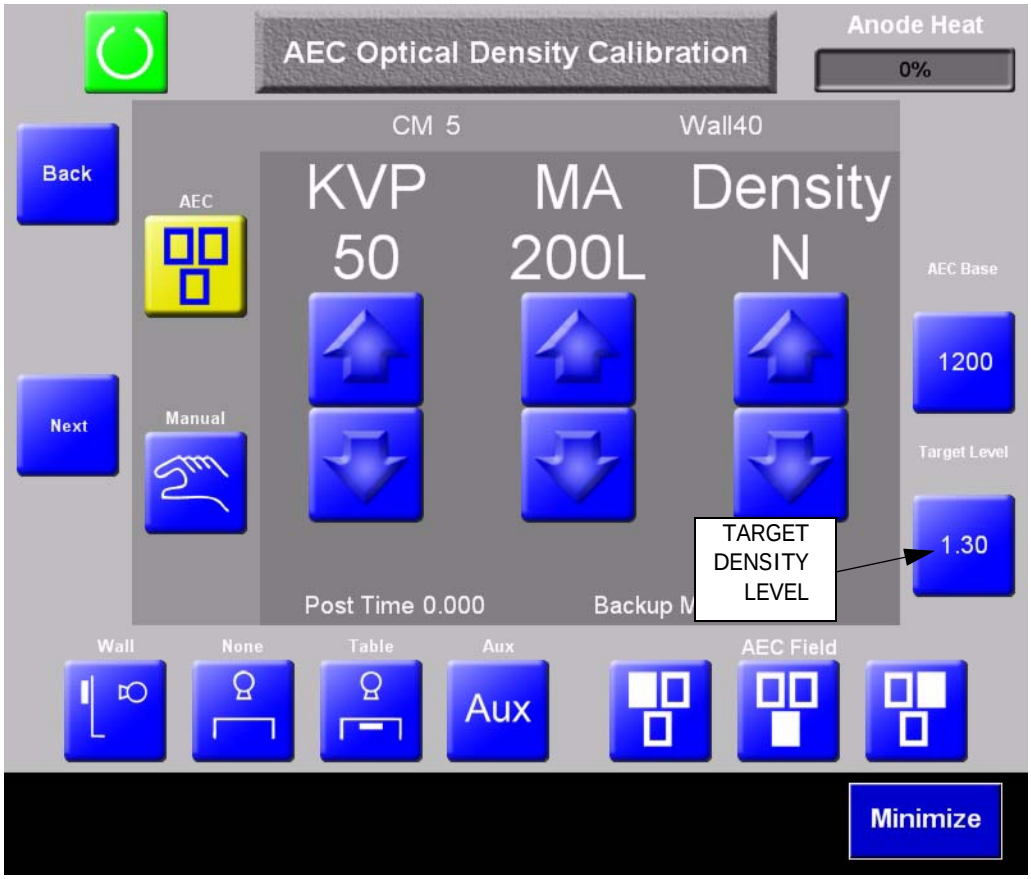


Figure B-27. AEC Optical Density Calibration Screen

2. If the selected film/screen combination is the first one to be calibrated with the system, perform the following steps:

   a. Set the ion chamber detector selection to middle detector and ensure x-ray tube is at correct SID. Ensure the ion chamber has been balanced.

   b. Place 5 cm of acrylic in the X-ray beam.

   c. Set the "Target Level" to the desired level (e.g., "1.30" as shown in the figure above). To do so, press the Target Level value button (located directly below "Target Level" label), use the keypad to input the desired value, then press **Enter**. *Do not change the Target Level setting at any time during this procedure.*

d. Take an exposure at the setting indicated on the AEC Optical Density Calibration Screen (i.e., 50 kVp, 200L mA, normal density).

e. Process the CR Film Plate to determine density level (referred to as the "LGM" value).

f. If the LGM value is within acceptable range of the Target Level as defined by the CR Film Plate manufacturer, press the **Next** button to save the setting and proceed to AEC KV Calibration.

g. If not within range, perform the following adjustments:

NOTE

The series of AEC optical density measurements should be repeated as many times as required until optical density is sufficiently accurate to meet regulatory and facility requirements.

Note: If the system is equipped with "standard type" AEC Board A11 (AY40-031S), the "Table Gain Adj. Potentiometer" is A11R22 and the "Wall Gain Adj. Potentiometer" is A11R23. If the system is equipped with "Universal type" AEC Board A11 (AY40-027S), the "Table Gain Adj. Potentiometer" is A11R77 and the "Wall Gain Adj. Potentiometer" is A11R79.

i. Adjust Table Gain Adj. potentiometer (if calibrating the table receptor) or Wall Gain Adj. potentiometer (if calibrating the wall receptor), and repeat exposure. Continue until the measured LGM value equals the Target Level setting to within CR System manufacturer's specification.

ii. If you still cannot achieve the Target Level setting, set Table Gain Adj. potentiometer (if calibrating the table receptor) or Wall Gain Adj. potentiometer (if calibrating the wall receptor) to mid-range, then adjust the ion chamber's MASTER GAIN potentiometer until roughly the desired LGM is obtained. Further fine-tuning can then be achieved by adjusting the Table or Wall Gain Adj. potentiometer as described in the previous step.

iii. If the measured LGM value still does not equal the Target Level setting even with the ion chamber's MASTER GAIN potentiometer set to maximum gain position, increase each chamber detector gain and perform the "AEC MAS Balance Verification" procedure. Repeat AEC Optical Density calibration.

iv. If the measured LGM value still does not equal the Target Level setting after adjusting the MASTER GAIN and gain of individual detectors, reduce the AEC Reference until you obtain the desired LGM value.

3. If the selected film/screen combination is not the first one to be calibrated with the system, perform the following steps:

i. Set the "Target Level" to the desired level (e.g., "1.30" as shown in Figure 3-27). To do so, press the Target Level value button (located directly below "Target Level" label), use the keypad to input the desired value, then press **Enter**. *Do not change the Target Level setting at any time during this procedure.*

ii. Place 5 CM of acrylic in the X-ray beam.

iii. Take an exposure at the setting indicated on the AEC Optical Density Calibration Screen (i.e., 50 kVp, 200L mA, normal density).

iv. Process the CR Film Plate to determine density level (referred to as the "LGM" value).

v. If the LGM value is within acceptable range of the Target Level as defined by the CR Film Plate manufacturer, press the **Next** button to save the setting and proceed to AEC KV Calibration.

vi. If LGM value is too low, press the AEC Base value button (located directly below "AEC Base" label). Increase the AEC Base value, press **Enter**, then repeat exposure. If density is too high, press the AEC Base value button, decrease the AEC Base value, then repeat exposure. Continue until the measured LGM value equals the Target Level setting to within CR System manufacturer's specification.

4. Press the **Next** button to advance to AEC KV Calibration.

IMPORTANT! To ensure AEC density is correctly calibrated to the desired "target" density setting, either the AEC Base value must be adjusted to obtain the target density level (verified using the processed CR Film Plate) or the target density level shown on the AEC Optical Density Calibration Screen must be set to the actual LGM value obtained from the processed CR Film. For example, the calibrator would like the system AEC density to be "2.10". The calibrator must adjust the "AEC Base" value until the actual measured LGM value of the CR Film Plate is 2.10. However, if the actual measured LGM value of the CR Film Plate is 2.20 and you decide not to continue to adjust the AEC Base to achieve exactly 2.10 density, then change the Target Level setting shown on the AEC Optical Density Calibration Screen to "2.20".

AEC KV Calibration Procedure

The AEC KV Calibration screen (shown below) is used to calibrate the tube voltage to the "Target Level" density setting. There are a total of six kV calibration points for a 125 kV system (50, 60, 80, 100, 110, and 120 kV); 150 kV systems require an additional two kV calibration points (130 and 140 kV). The image receptor and chamber field settings remain the same as those used in the AEC Optical Density Calibration procedure.

1. Access the AEC KV Calibration Screen (shown below) and proceed as follows.

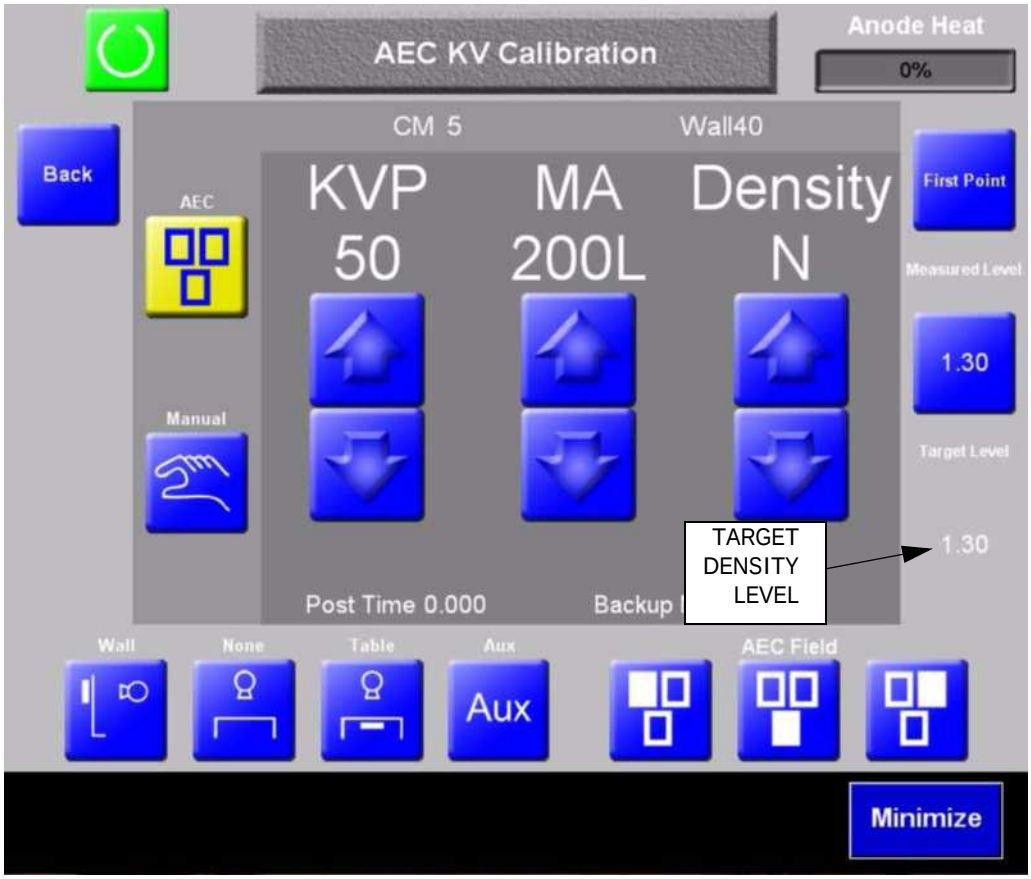


Figure B-28. AEC KV Calibration Screen

2. Place indicated thickness of acrylic (5 CM for first calibration point) in the X-ray beam.
3. Insert a CR Film Plate and collimate down to film size.
4. Take an exposure at the setting indicated in the AEC KV Calibration Screen (i.e., 50 kVp, 200L mA, normal density).

NOTE
Calibration of the first step (50 kVp) is not required as long as AEC Optical Density Calibration procedure in the previous steps was performed prior to AEC KV Calibration. A verification that the "Measured LGM" is the same as the "Target Level" setting is all that is required.

5. Process the CR Film Plate to determine the density level (referred to as the "LGM" value).

   a. If the sensitivity value is within acceptable range as defined by manufacturer, press the **First Point** button to proceed to the next AEC kV calibration point.

   a. If not within range, press the Measured Level value button (located directly below "Measured Level" label), and enter the measured LGM value using the keypad, then press **Enter**. Press **First Point** button to proceed to the next AEC kV calibration point. *DO NOT TAKE ANY FURTHER EXPOSURES AT THIS SETTING.*

6. Repeat the previous steps for the 60, 80, 100, 110, 120, and, if 150 kV system, 130 and 140 kV calibration points, placing the specified thickness of acrylic in the x-ray beam as indicated on the AEC KV Calibration screen for each kV calibration point, and taking one exposure per kVp calibration point until all the measured density (LGM) values are within required range.

7. Press the **Back** button to return to the AEC Calibration menu.

8. This completes AEC calibration for this particular film/screen combination. Repeat AEC calibration procedures for all additional film/screen combinations that will be used with the system.

9. Verify AEC calibration by taking several exposures in AEC mode and checking the resulting "LGM" value. If necessary, repeat AEC calibration procedure to further adjust AEC accuracy.

Appendix C

Log4View Error Logger

QUANTUM LOGGING VIEWER (LOG4VIEW) USER INSTRUCTIONS

GENERAL DESCRIPTION

The log viewing program, Log4View, is used to view errors, warnings and other informational events that have occurred with your integrated system. Every time any of the Quantum Programs that form the integrated system make a significant action, it is recorded in a log file. This includes normal operations because all may be useful in both viewing normal customer operation as well as error conditions. These events will help diagnose the state of equipment in the field.

The Log4View program is installed along with the Integration System software installation. It is a separate program that is accessible outside of the digital operations. It creates an icon on the desktop that will allow the log to be viewed at any time.

The following instructions for use are separated into two sections:

- Agfa (DiRex) Integration Log4View User Instructions
- Canon (QG-DIG-CXDI) Integration Log4View User Instructions

Refer to the appropriate section corresponding with the type integration utilized with this HF Series X-ray Generator.

Note: The Quantum logging facility is only for events within Quantum's Integration System – The associated CR or DR system workstation has its own logging system and viewer.

AGFA (DIREX) INTEGRATION LOG4VIEW INSTRUCTIONS FOR USE

1. From within the NX Program select Main Menu (A) and Desktop (B) (Figure 1).

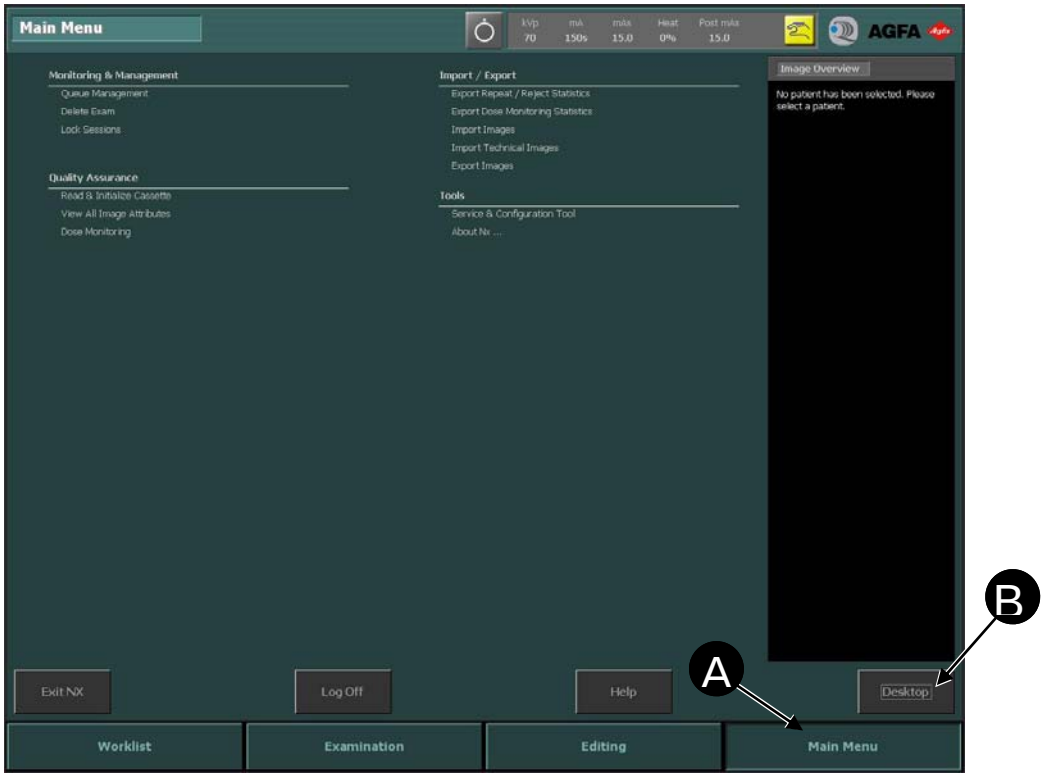


Figure 1. AGFA NX Program

2. The Windows desktop will appear: Click on the Windows “Start” button.
3. Position the mouse pointer over the “Quantum” shortcut, then select “Logs” which allows you to choose from one of five logs configured during software install (refer to the following figure).

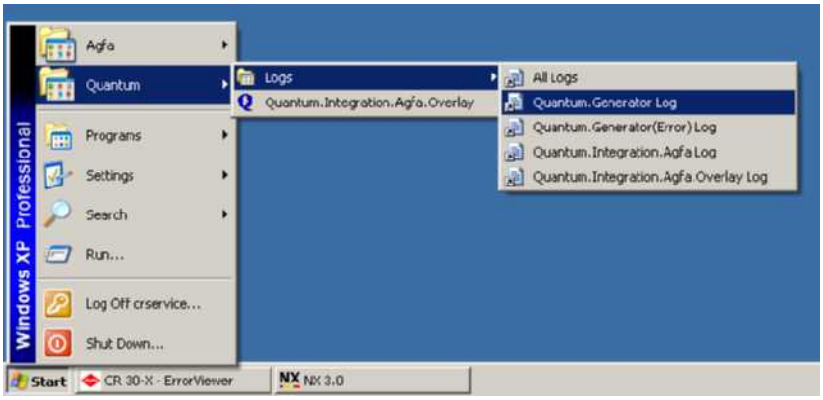


Figure 2. Quantum Logs

4. At this point a log would be chosen based on the type of information being sought.
    - ***All Logs***: All messages
    - ***Quantum.Generator Log***: All generator related messages
    - ***Quantum.Generator(Error) Log***: All generator error messages (In Red)
    - ***Quantum.Integration.Agfa Log***: Communication debugging between the Agfa software and the Quantum Overlay
    - ***Quantum.Integration.Agfa.Overlay Log***: Communication Debugging between the Quantum Overlay, Quantum Generator and Agfa software.
5. The display is of events that have occurred during the operation of the generator. The date and time stamp lets you determine what occurred and when. Refer to the following figure which shows an example of "Quantum.Integration.Agfa.Overlay" log.

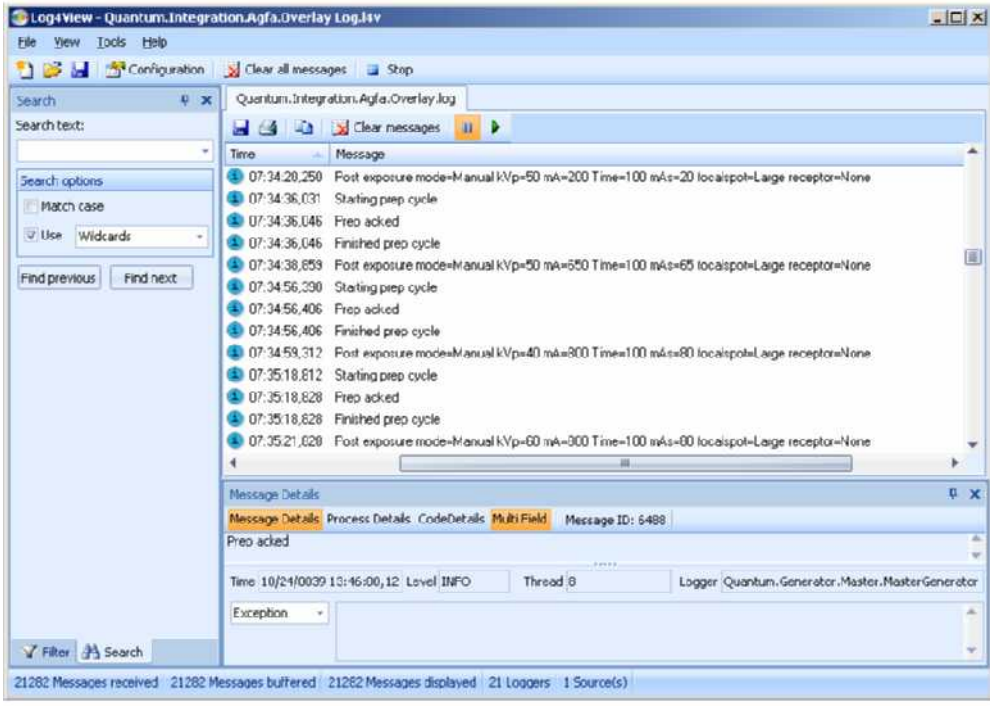


Figure 3. Sample Quantum Integration Agfa Overlay Log

6. If you need to look either at other events in the system and / or non-error events, you can select another log per step three (3) to view the events of that log.

Note: If Log4View logs are requested by Quantum Medical Imaging's Service or Engineering departments for analysis, they are located in:

Note: If Log4View logs are requested by Quantum Medical Imaging's Service or Engineering departments for analysis, they are located in "C:\Agfa\Healthcare\Nx\Bin\Quantum\Logs".

Best practice would be to email the entire "Quantum" folder to avoid multiple file requests.

CANON (QG-DIG-CXDI) INTEGRATION LOG4VIEW INSTRUCTIONS FOR USE

1. Press the Windows key (⊞) on the Canon Workstation keyboard. The Windows taskbar will appear: Click on the Windows "Start" button.
2. Select **Programs.**
3. Select **Quantum Logs.**
4. Choose from one of two logs (**Quantum Log.l4v** or **Quantum Generator Error.l4v**) configured during software install as shown in the sample screen below:

Figure 4. Accessing Quantum Logs

The Quantum logs available

- ***Quantum Log.l4v***: All messages
- ***Quantum.Generator(Error) Log***: All generator error messages (In Red)

5. The logs contain a list of events that have occurred during the operation of the generator. The date and time stamp lets you determine what occurred and when. Refer to the following figure which shows an example of "Quantum Log.l4v" log.

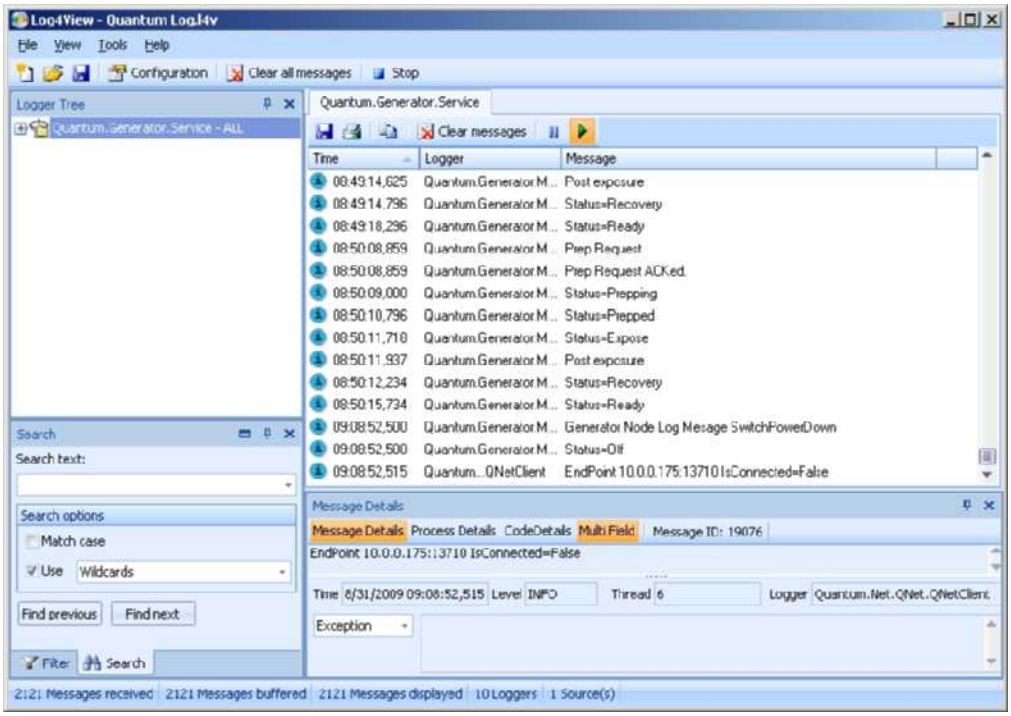


Figure 5. Sample Quantum/Canon Integration Generator Log (Quantum Log.l4v)

6. If you need to look either at other events in the system and / or non-error events, you can select another log per step four (4) to view the events of that log.

Note: If Log4View logs are requested by Quantum Medical Imaging's Service or Engineering departments for analysis, they are located in:

<u>Canon Integration (QG-DIG-CXDI)</u>

Quantum.Generator.Log – "C:\Program Files\Quantum\Quantum Generator Service\Quantum\Logs"

Quantum.Integration.Canon.Log – "D:\ccr\Quantum\Logs"

Best practice would be to email the entire "Quantum" folder to avoid multiple file requests.

Appendix D

CALIBRATION
(Using Generator Service Tools

THIS SECTION ONLY APPLICABLE ON HF SERIES GENERATORS EQUIPPED WITH Q-CONNECT (ETHERNET) OPTION

(EXCEPT DIREX - SEE APPENDIX B)

Appendix D Calibration (Using Generator Service Tools)

OVERVIEW

This appendix provides instructions for configuring and calibrating the HF Series X-ray generator on systems equipped with the Q-Connect option (ethernet adapter), with the exception of Agfa DiRex Integration Systems (covered in Appendix B). Generator Configuration and Calibration can only be performed using the generator's "Insight", Generator Configuration, and Calibration Wizard service tools installed on the computer serving as the generator operator control panel (i.e., Q-VISION all-in-one PC or digital imaging system workstation computer).

If this is a Quantum/Canon Integration (QG-DIG-CXDI Integration System), refer to Model QG-DIG-CXDI Canon/Quantum Integration Service Manual DC30-094 for system interconnection and integration software installation instructions.

NEMA Standards Publication/No. XR8-1979(R1994), Test Methods for Diagnostic X-ray Machines for Use During Initial Installation is recommended as a reference.

REQUIRED TOOLS AND MATERIALS

The following lists the tools and materials required to perform the procedures contained in this chapter:

- Digital Voltmeter: Fluke Model 87 (or equivalent)
- Non-invasive kV, mAs, mR meter or Radcal Dynalyzer III (or equivalent)
- Oscilloscope, 50 Mhz storage: Tek 2210 (or equivalent)
- 5 CM, 10 CM, 15 CM, 25 and 30 CM acrylic phantoms (required for calibrating systems equipped with QG-AEC option).

ACCESSING GENERATOR SERVICE TOOLS

The way in which the generator's service tools are accessed differs depending on the operator control panel configuration of the HF Series X-ray generator (i.e., if it is equipped with either a Q-VISION operator control panel or a Workstation-based operator control panel). However, once the service tools have been accessed, the configuration and calibration screens are identical. Refer to the appropriate section that follows depending on the type operator control panel your system uses.

Before starting, be sure the following steps have been performed:

1. If this is an integration system (i.e., generator is integrated with a workstation computer for use as the operator control panel), ensure the DR system's Computer Workstation is properly connected to the generator, and the integration system software is installed and configured in accordance with the instructions provided in the Integration Service Manual.
2. Ensure the Power/Expose Control Box (AY20-265) is properly connected to the generator as described in Chapter 2, ASSEMBLY & INSTALLATION.
3. Set the ON/OFF circuit breaker CB1 on the generator cabinet to ON position.

4. Set the power on/standby switch on the Power/Expose Control Box to the standby (⏻) position, then to the on (⊙) position. The green power LED lamp should illuminate.

Accessing Generator Service Tools - Q-VISION Operator Control Panel

The following instructions apply to generators utilizing a Q-VISION operator control panel (OCP).

1. To gain access to the Generator Service programs, touch the Help button located on the lower right corner of the Q-VISION screen (shown on right). The Generator Help Services Screen (Figure D-1a) appears:

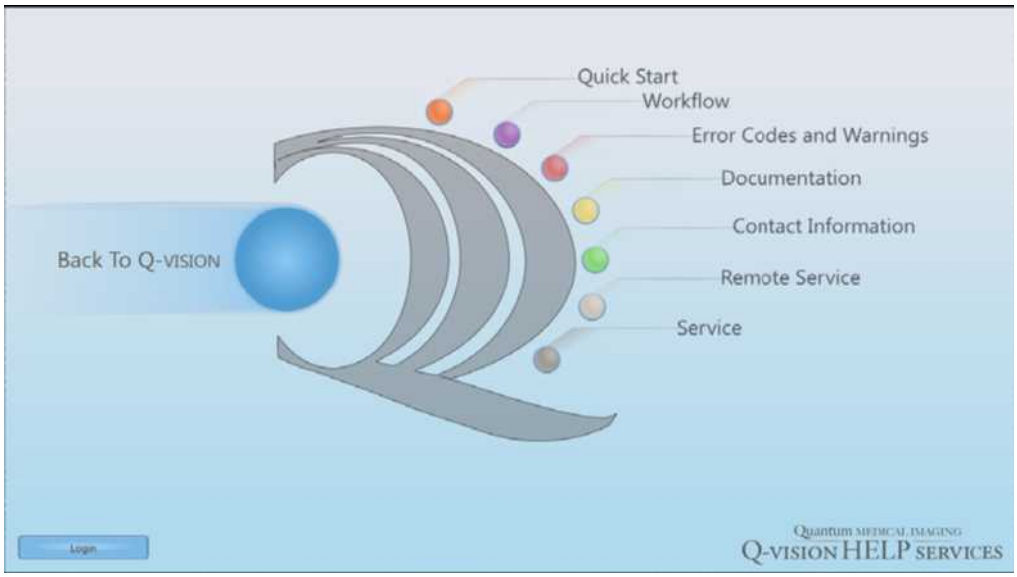


Figure D-1a. Generator Help Services Screen

2. Touch the Login button at the lower left corner of the screen. A password entry keypad displays.

Figure D-1b. Enter Password Screen

3. In the Enter Password screen, enter the default Service Technician password (58623) using the keypad, then select **Enter**. The word "Login" is replaced with "FieldTech" on the Generator Help Services screen to indicate successful login.

4. On the Generator Help Services screen, select **Service** option. The General Service Options Menu appears:

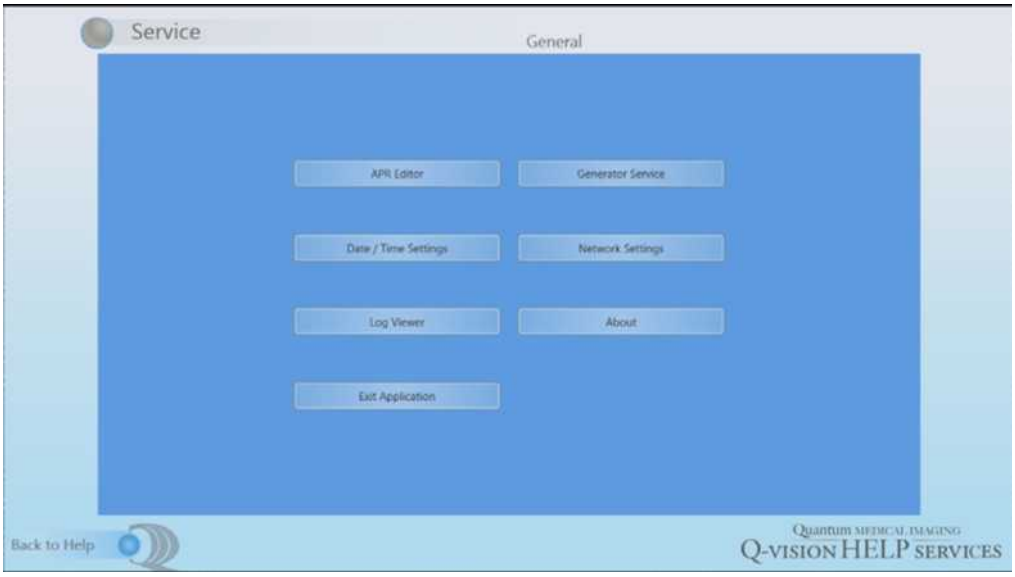


Figure D-1c. General Service Options Menu

5. Select **Generator Service**. The following screen appears:

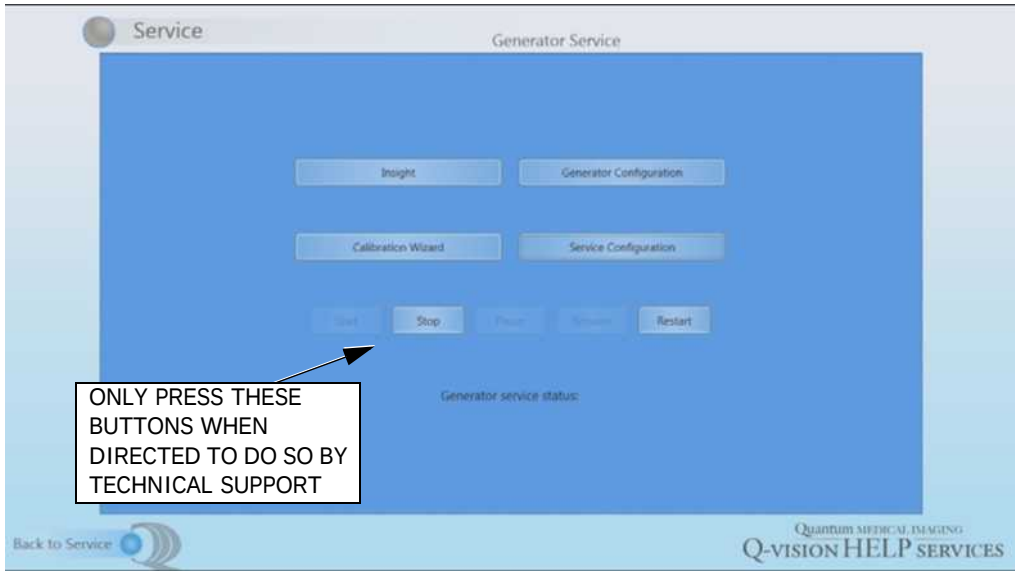


Figure D-1d. Generator Service Options Menu

6. Proceed to SYSTEM CONFIGURATION/CALIBRATION section.

Accessing Generator Service Tools - Workstation-Based Operator Control Panel

The following instructions apply to generators utilizing a workstation-based operator control panel (OCP) such as Quantum/Canon Integration (QG-DIG-CXDI Integration System).

1. Right mouse click on the Generator Service Monitor icon "Q" (left), which is displayed in the MS Windows Task Bar located in the lower right side of the screen (see Figure D-1e).

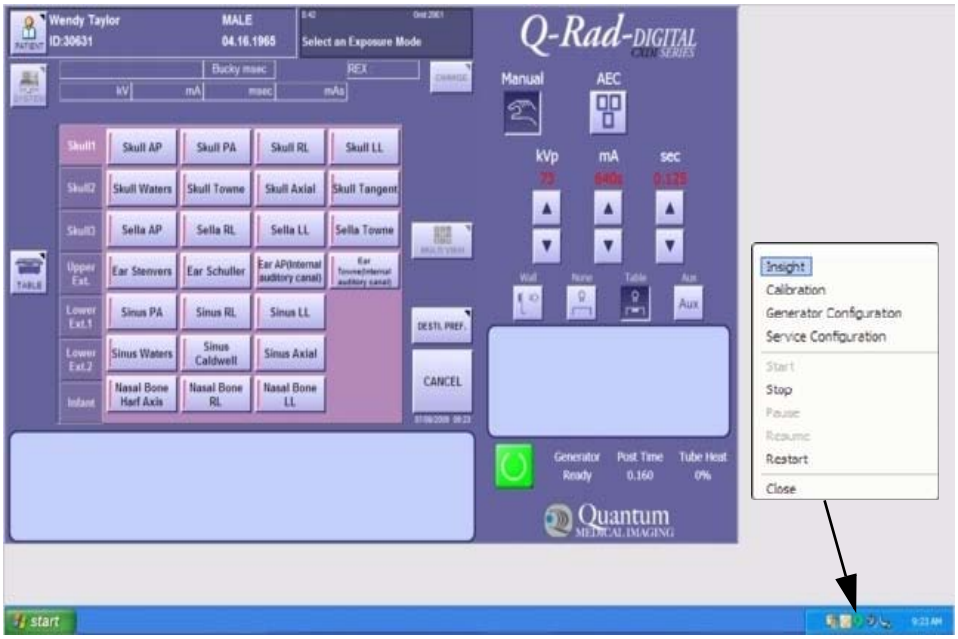


Figure D-1e. Sample Screen - Generator Service Monitor Icon ("Q")

As shown above, right mouse clicking on the Service Monitor icon will present four service tool choices:

- Insight - Provides information regarding current Generator configuration settings.
- Calibration - An interactive program that facilitates calibration of Generators compatible with Model QG-DIG-CXDI, Quantum/Canon Integration System.
- Generator Configuration - Provides access to all Generator, Receptor, Ion Chamber, and X-ray Tube settings.
- Service Configuration - Provides the Technician with access to the Service Configuration Menu for the purpose of identifying the IP Address of the Generator, and commanding the System to automatically upload all necessary identification data required by the interface software. Details regarding this feature are provided in Model QG-DIG-CXDI Integration System Service Manual DC30-094.

2. Select **Generator Configuration**.

3. The "Enter Password" screen appears (see Figure D-2.).

Figure D-2. Enter Password Screen

4. In the Enter Password screen, enter the default Service Technician password (**58623**) using the keypad, then press **Enter**. This password enables access to the Generator Configuration program.

5. Upon validation of the password, the Load Configuration menu displays:

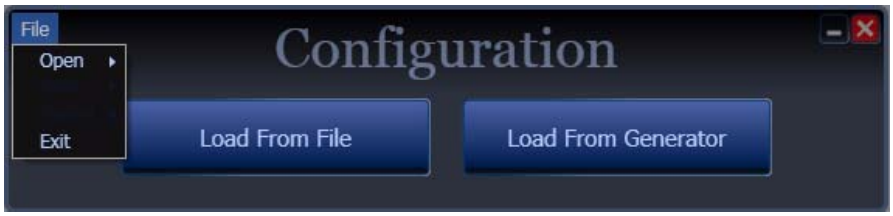


Figure D-3. Load Configuration Menu

The Load Configuration menu offers two choices:

- Load From File - Opens a browser window to load a previously saved configuration file stored on the Workstation Computer (refer to Factory Reset description in this chapter for instructions on creating a configuration file of the generator).

- Load From Generator - Select to load the last automatically-saved generator configuration (Note: The configuration file is automatically backed up every time the Workstation Computer establishes a connection to the generator.) the currently active configuration (This option should be selected under normal circumstances; only when a problem occurs with the system should the Load From File option be selected).

6. Select **Load From Generator**. The Configuration Menu displays:

Figure D-4. Configuration Menu - Generator Settings Tab

SYSTEM CONFIGURATION/CALIBRATION

The HF Series x-ray generator has been factory configured and calibrated. It is necessary, however, to perform the following procedures to verify system configuration and performance (calibration). Perform the procedures in the sequence presented, unless otherwise instructed.

The Configuration Menu provides access to all of the generator's configurable settings organized into seven functional groups, as represented by the following tabs:

- Generator Settings - Includes generator power derating, Timeout (sleep), AEC Board Type, and AEC Backup mAs settings
- Generator Calibrations - Dates and times when kVp, mA, Filament, and A-D Voltage calibrations were last performed
- Tube Settings - Tube Type, Rotor Type, Tube Power Output Derating, and Tube Temperature (Heat Warning) alert settings

- Physical Receptors - Defines number, type and identification of connected receptors *(contains only factory-authorized settings, not field configurable)*
- Receptors - Enables the creation and identification of AEC calibration profiles associated with each physical receptor (e.g., wall or table) utilized in the system.
- Ion Chambers - Defines ion chamber type associated with each of the physical receptors above, and includes relevant configuration settings for each (i.e., detector assignments, polarity, output, etc.)
- Licensing - Provides Generator License validation and updating utilities (intended for use only under the direction of Quantum Technical Support)

For proper operation of the generator, the settings must accurately reflect the actual configuration of the generator. Typically, these settings are made at the factory in accordance with customer sales order specifications. However, it is recommended that you review the current configuration settings for accuracy. The following paragraphs provide specific instructions for setting each of the available configuration selections.

GENERATOR CONFIGURATION

The Generator Configuration program is run first - to verify all settings are correct, followed by Calibration - to ensure optimal generator performance. To gain access to either of these utilities, password entry is required. This is to prevent unintended and/or unauthorized changes to system settings.

Generator Settings Tab

If not already done so, select the **Generator Settings** tab on the Configuration Menu. The Generator Settings, shown in Figure D-4, includes controls for setting the generator power output derating (presented as a percentage of total power output (kW)), sleep mode timer, AEC Board Type, and AEC Backup mAs settings.

1. **DeratingPercentage** - The derating function is used to limit the output of the system to a percentage of the maximum energy capacity. To derate the energy output, move the slide control adjacent to the **DeratingPercentage** field to the desired derating percentage (choices are 80%, 85%, 90%, 95% or 100% [i.e., no derating]).
2. **Timeout**: The "timeout" period selected represents the amount of delay time after which, if no user activity is detected, the system automatically enters Power Stand By mode. This mode is entered to help reduce power consumption while protecting system electronics. The timeout period is selectable in 30 minute increments between 0 minutes up to 180 minutes. If "Infinity" is selected, the generator will not timeout, however, the filament will turn off if one hour of inactivity.
3. **AECBoardType**: Displays the AEC Board type installed in the generator (when equipped with AEC option):
   a. Select "Standard" if generator is equipped with standard type AEC Board A11 (AY40-031S)
   b. Select "Universal" if generator is equipped with universal type AEC Board A11 (AY40-027S)
   c. Select "None" if generator is not equipped with optional AEC
4. **AECBackUp Mas**: Sets the current system-wide backup mAs setting effective on all AEC exposures. The maximum back up mAs setting is 600; note that on certain model generators, such as the Stored Energy models, the maximum mAs capability of the generator is less than 600 mAs. Therefore, the backup mAs setting should not exceed the maximum MAS output of the generator. Refer to Chapter 1, SPECIFICATIONS for a list of the mAs ratings by model number.

Generator Calibrations Tab

Selecting the Generator Calibrations tab on the Configuration Menu displays the following screen:

File
Configuration
Physical Receptors
Ion Chambers
Receptors
Licensing
Generator Settings
Generator Calibrations
Tube Settings
Kv Calibration Date: 5/14/2009 4:10:23 PM
Ma Calibration Date: 5/14/2009 4:10:23 PM
Small Filament Calibration Date: 5/14/2009 4:16:11 PM
Large Filament Calibration Date: 5/14/2009 4:10:23 PM
Adc Cathode Calibration Date: 5/14/2009 4:10:23 PM
Adc Anode Calibration Date: 5/14/2009 4:10:23 PM
Adc +15V Calibration Date: 5/14/2009 4:10:23 PM
Adc -15V Calibration Date: 5/14/2009 4:10:23 PM
Adc +24V Calibration Date: 5/14/2009 4:10:23 PM
Adc Brake Calibration Date: 5/14/2009 4:10:23 PM
Adc +5 Calibration Date: 5/14/2009 4:10:23 PM

Figure D-5. Configuration Menu - Generator Calibration Tab

This screen displays the dates and times when kVp, mA, Filament, and A-D Voltage calibrations were last performed. This screen is provided for informational purposes only; there are no settings required.

Tube Settings Tab

The Tube Settings Tab Screen, shown below, displays the current tube type (model) and rotor settings. Also provided are the Tube Derating (Tube%) and Heat Warning (Heat% Limit) settings. The tube model and rotor settings are preset at the factory and normally should not be changed, except after replacing the existing tube with a different type tube. *(Note: Consult Quan-*

tum Service Department before attempting to re-configure the generator with a tube type that is different than the factory-configured tube type.)

Figure D-6. Configuration Menu - Tube Settings Tab

1. To change the tube model setting, touch or mouse click on the **Tube** field. A drop down list box will open. Scroll through the available tube types and select the desired model.
2. To change the tube rotor setting, touch or mouse click on the **Rotor Type** field. A drop down list box will open. Scroll through the available rotor drive settings: 50 Hz (no high speed starter), 60 Hz (no high speed starter), AID external high-speed starter (AID HSS), or Quantum internal high-speed starter (QMI HSS).

Note: On systems equipped with high-speed starter option (HSS), tube "high-speed" mode will only be activated when selected exposure factors exceed the limits used for low-speed operation.

3. The Tube Derating setting provides derating of the tube's maximum mAs output in percentages of 80%, 85%, 90%, 95% or 100% (i.e., no derating). For example, if at a particular kV and mA the tube normally allows a 10 mAs exposure, then at 80% derating, the tube would permit only an 8 mAs exposure. Derating the tube can extend the life of the tube. Move the slide control adjacent to the **Derating** field to choose a derating percentage.
4. The Heat Warning (heat%) provides a heat protection function for the x-ray tube. For example, setting the Heat Warning for 80% will cause the generator to produce an audible alarm and a visual "Heat Alarm" indication on the OCP when the tube has reached 80% of its total heat unit capacity. The total tube heat unit capacity is dependant upon the tube type. The Heat Warning setting has an adjustment range of anywhere

between 50% up to 100% in 10% increments. Note: At 100% setting, the heat alarm is effectively disabled. Move the slide control adjacent to the **Heat Warning** field to select the percentage of the total tube heat capacity at which alarm activation will occur.

Physical Receptors Tab

The Physical Receptors Tab (see below) is used to configure the number, type and identification of connected receptors *(contains only factory-authorized settings, not field configurable)*.

Figure D-7. Configuration Menu - Physical Receptors Tab

Receptors Tab

The generator has been pre-configured with six "logical" receptor selections designated "None", "Table", "Wall", "Wall72", "Wall2", and "Aux" to choose from as shown below (at left side of screen) in the Receptors Tab Screen.

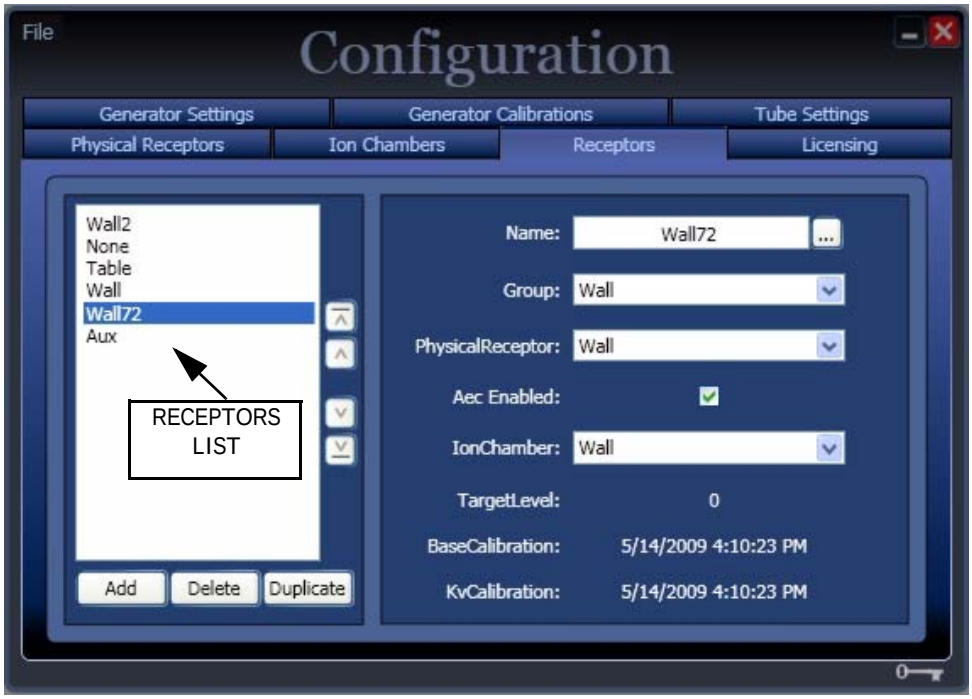


Figure D-8. Configuration Menu - Receptors Tab

Logical receptors are created in order to store AEC calibration profiles, following execution of the AEC Calibration function. For example, when a portable receptor (e.g., Canon CXDI-50G) is used on a system equipped with AEC, the default "Wall" receptor might be renamed "50G" as shown in Figure D-8 above. Following this, AEC Calibration would need to be performed with Canon portable receptor inserted in the wall stand, which in this case, is the physical receptor as defined in the PhysicalReceptor field shown in the Configuration menu above. In another case, where a system is equipped with two fixed receptors, such as one in the wall stand and one in the table, there would need to be two logical receptors created (for example - "Canon Table" and "CanonWall"), and each would require independent AEC Calibrations be performed since each location would have its own ion chamber.

The Configuration Menu - Receptors Tab displays the system default receptors and settings. The system default receptors shown in the list can be renamed and deleted, or new receptors added as necessary to suit your particular facility requirements. To change the default receptor settings, proceed as follows:

1. In the receptors window, select a receptor in the list to modify.
2. To rename the receptor, select the **Name** field (touch the field or left mouse click on the three dots at the right end of field). A data entry keyboard will display. Using the keyboard, edit the receptor name as required, then press the **Enter** key.
3. The **Group** field setting identifies which of the four Receptor buttons on the operator control panel (Wall, None, Table, or Aux) will be linked with this particular receptor. To change the "Group" setting, touch or mouse click on the **Group** field. A drop down list box of the receptor buttons will open. Select the desired receptor button. *(Note: The Aux button is only functional on generators equipped with "Universal" type AEC.)*
4. The **PhysicalReceptor** field setting identifies the receptor location where the ion chamber is physically located (Table, Wall, Wall2, or Aux). Wall and Wall2 are generally used for separate calibrations of 40 and 72 SID locations of a wall cassette holder. To change the "PhysicalReceptor" setting, touch or mouse click on the **PhysicalReceptor** field. A drop down list box containing the physical receptors will open. Select the desired receptor. *(Note: The Aux and Wall2 receptors are only functional on generators equipped with "Universal" type AEC.)*
5. **Aec Enabled** Check box: Select "Aec Enabled" to enable AEC operation with this receptor. The only receptor not enabled for AEC is "None".
6. The Target Level, BaseCalibration and KvCalibration are display only fields. Target Level is this desired optical density value selected during AEC calibration; Base and kV calibration dates and times indicate the last time AEC calibration was performed.
7. The **Add**, **Delete** and **Duplicate** buttons below the receptors window provide the ability to add new receptors and delete existing receptors from the list, and duplicate existing receptors for the purpose of creating copies for modification.

Ion Chambers Tab

The Ion Chambers Tab (see Figure D-9), displays available ion chambers interfaced to the HF Series X-ray generator, including configuration settings for each.

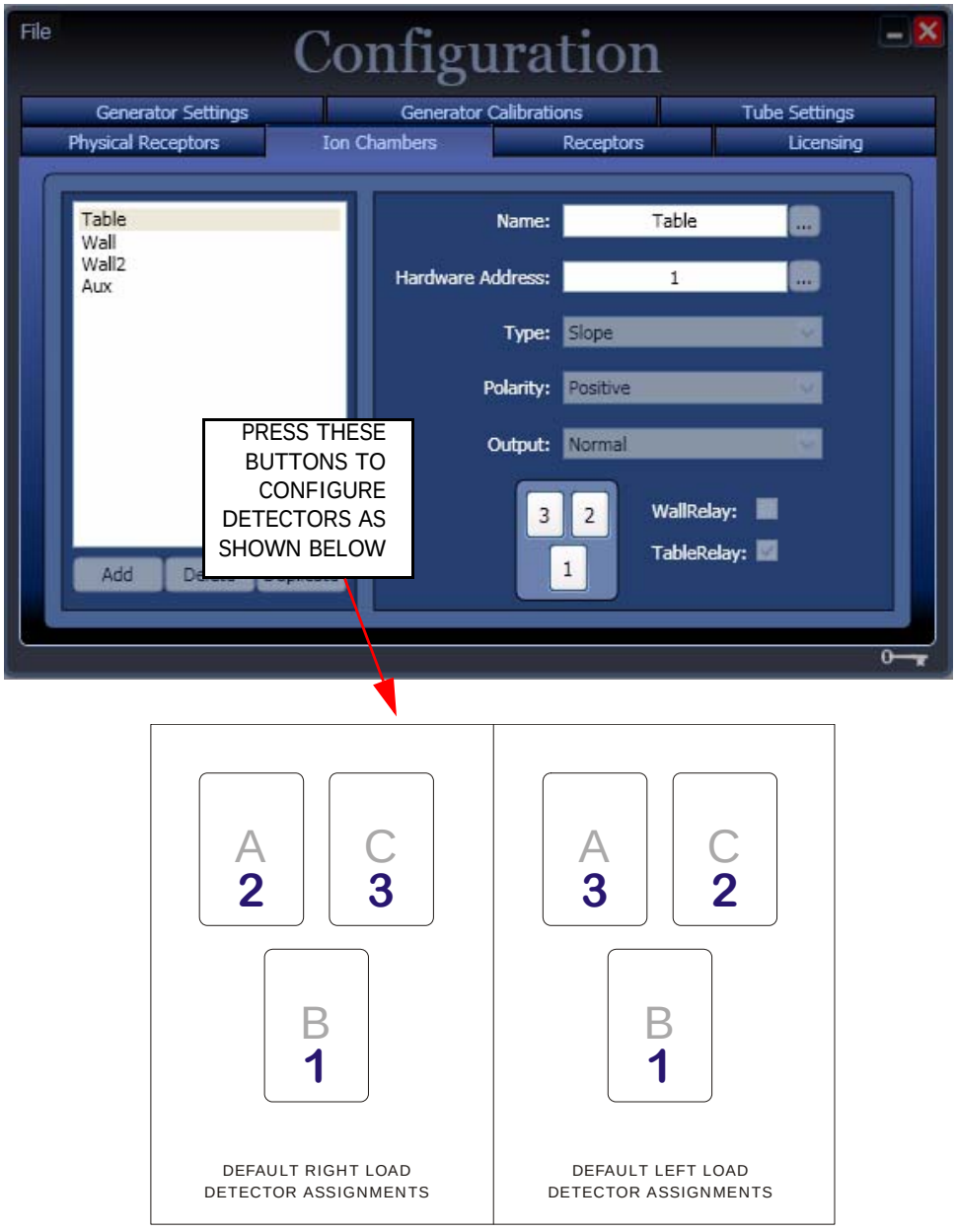


Figure D-9. Configuration Menu - Ion Chambers Tab

Note: On systems equipped with a "Standard" type AEC Board (AY40-031S), the "Wall2" and "Aux" selections are not used. These choices are only effective if the generator is configured with "Universal" type AEC Board (AY40-027S). Be sure that the selected ion chamber is properly interfaced to AEC Board A11 as described in Chapter 2, ASSEMBLY & INSTALLATION.

Initially, the Ion Chambers Tab screen will include system default ion chambers and settings as shown in Figure D-9. The only field configurable parameters are the assignment of ion chamber detectors (detector 1, 2, and 3) with respect to the generator's ion chamber detector select signals (i.e., FIELD SELECT 1, FIELD SELECT 2 and FIELD SELECT 3) generated by AEC Control Board A11. For example, assigning "2" to Field "A" enables detector "A" when the UPPER LEFT chamber detector field is selected at the Operator Control Panel.

The Ion Chamber Settings Screen also provides factory-configurable settings that facilitate proper compatibility of the generator with specific types of ion chambers. These settings include Ion Chamber Type (Slope/Level), Polarity (+/-), Output (Normal/Inverted), and Relay On/Off settings. Consult Quantum Technical Support for instructions on re-configuring these settings.

To change the default ion chamber detector settings, proceed as follows:

7. In the ion chambers window, select an ion chamber in the list to modify.
8. Press the ion chamber detector (Field 1, Field 2 or Field 3) and choose the desired detector setting (1, 2, 3 or Off).

IMPORTANT: The AID ICX-153 or ICX-1153 ion chamber, which is the default chamber type shipped with standard AEC type generators, requires that detector "A" = 2, "B" = 1, and "C" = 3. The factory default orientation of the ion chamber mounting in the bucky is with the front side toward the tube. However, it may be necessary to mount the chamber with the back side forward (e.g., for left side loading wall stands). In this case, in the Ion Chamber Settings screen, simply switch assignment of chamber detector "A" to 3 and detector "C" to 2. No wiring modifications are necessary.

Licensing Tab

The Licensing Tab Screen (see below) is used to validate and add new licenses associated with the generator. These operations should only be performed under the direction of Quantum's Technical Support staff.

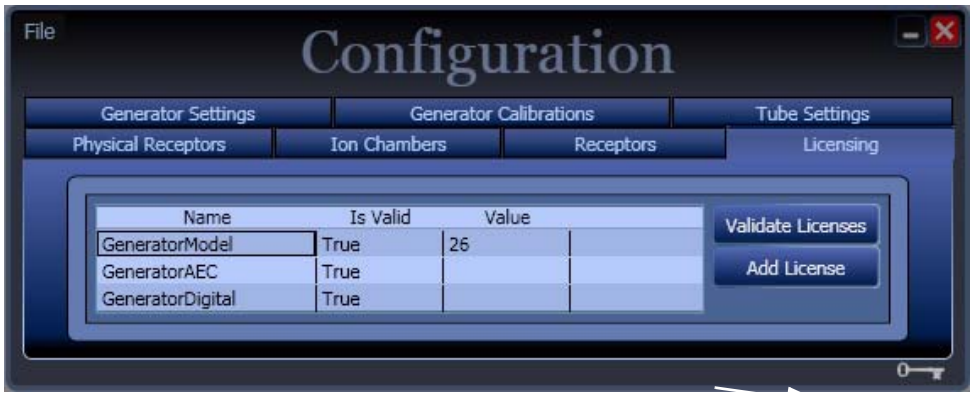


Figure D-10. Configuration Menu - Licensing Tab

GENERATOR CALIBRATION

CAUTION! Before calibrating unit, perform warm-up procedures recommended by tube manufacturer or the warm-up procedure described in Chapter 3 of the Operator's Manual.

WARNING! The following calibration procedures involve taking x-ray exposures. All personnel should be behind protective barriers during exposure. X-rays can be dangerous unless proper precautions and procedures are adhered to.

The generator was pre-calibrated at the factory, however, the system will need to be re-calibrated to assure proper operation, verify compliance and set AEC optical density (on systems equipped with AEC option). Prior to performing Generator Calibration, the Generator Configuration program must be run first as described in the preceding paragraphs. To gain access to the Generator Calibration utility, password entry is required. This is to prevent unintended and/or unauthorized changes to system settings.

1. Right mouse click on the Generator Service Monitor icon "Q" located in the lower right side of the screen.
2. Select **Generator Configuration**.

3. The "Enter Password" screen appears (see Figure D-11.).

Figure D-11. Enter Password Screen

4. In the Enter Password screen, enter the default Service Technician password (**58623**) using the keypad, then press **Enter**. This password enables access to the Generator Calibration program.

4. Upon validation of the password, the Load Configuration menu displays:

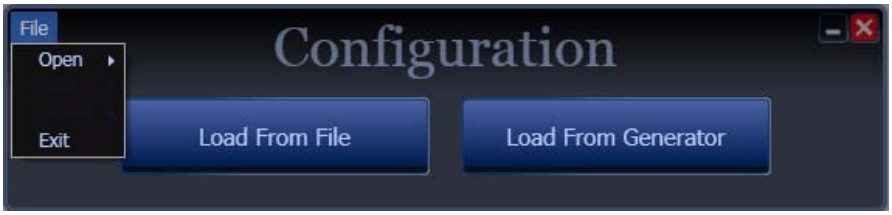


Figure D-12. Load Configuration Menu

The Load Configuration menu offers two choices:

- Load From File - Opens a browser window to load a previously saved configuration file stored on the Workstation Computer (refer to Factory Reset description in this chapter for instructions on creating a configuration file of the generator).

- Load From Generator - Select to load the last automatically-saved generator configuration (Note: The configuration file is automatically backed up every time the Workstation Computer establishes a connection to the generator.) the currently active configuration (This option should be selected under normal circumstances; only when a problem occurs with the system should the Load From File option be selected).

5. Select **Load From Generator**. The Calibration Wizard - Overview tab displays:

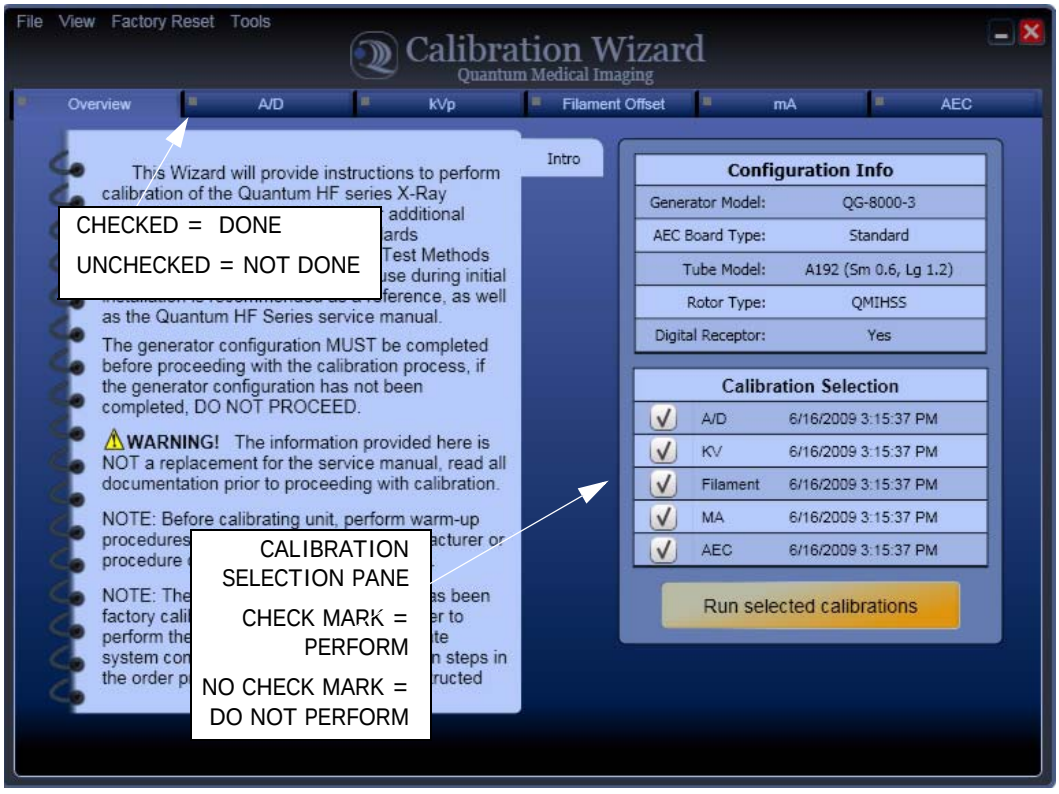

File View Factory Reset Tools
Calibration Wizard
Quantum Medical Imaging
Overview
A/D
kVp
Filament Offset
mA
AEC
Intro
This Wizard will provide instructions to perform calibration of the Quantum HF series X-Ray
as the Quantum HF Series service manual.
The generator configuration MUST be completed before proceeding with the calibration process, if the generator configuration has not been completed, DO NOT PROCEED.
WARNING! The information provided here is NOT a replacement for the service manual, read all documentation prior to proceeding with calibration.
NOTE: Before calibrating unit, perform warm-up
CHECKED = DONE
UNCHECKED = NOT DONE
CALIBRATION SELECTION PANE
CHECK MARK = PERFORM
NO CHECK MARK = DO NOT PERFORM
Configuration Info
Generator Model: QG-8000-3
AEC Board Type: Standard
Tube Model: A192 (Sm 0.6, Lg 1.2)
Rotor Type: QMIHSS
Digital Receptor: Yes
Calibration Selection
A/D 6/16/2009 3:15:37 PM
KV 6/16/2009 3:15:37 PM
Filament 6/16/2009 3:15:37 PM
MA 6/16/2009 3:15:37 PM
AEC 6/16/2009 3:15:37 PM
Run selected calibrations

Figure D-13. Calibration Wizard - Overview Tab

The Calibration Wizard provides a sequence of dialog boxes that leads the calibrator through a series of generator calibration steps, performed in a specific sequence. This wizard may be helpful especially to those who may be unfamiliar with this equipment. The "**Calibration Selection**" pane, shown in the sample screen above, identifies the calibration procedures to be performed as indicated by a check mark next to each procedure. The check mark is an active field; removing a check mark will eliminate that procedure from the performance sequence, adding a check mark includes it.

The Calibration Wizard is organized into six groups, as represented by the following tabs:

- Overview - Provides brief description of calibration Wizard and includes an activate/deactivate function to determine which generator calibrations to perform
- A/D - Accesses the analog-to-digital (A-D) converters calibration function
- kVp - Accesses KV calibration function
- Filament Offset - Accesses tube filament offset calibration function
- mA - Accesses mA calibration function
- AEC - Accesses the AEC optical density and AEC kVp calibration functions (active on systems equipped with AEC option only). Note that all of the AEC Calibrations must be performed for each table and/or film/screen combination used with the x-ray system. Selection of each film/screen type used with the system is explained in "CONFIGURATION SETTINGS" paragraph described previously in this chapter.

The paragraphs that follow describe the procedures for performing each of the above calibration functions. These procedures should be performed in the order presented. Note that any of the six calibration procedures may be directly accessed and performed by simply selecting the corresponding tab in the Calibration Wizard - Overview screen.

A/D Tab

The A/D (analog/digital converter) calibration utility is used to calibrate various essential supply voltages utilized by the x-ray generator against a pre-calibrated NIST-traceable voltage measurement instrument (such as a DMM). After A/D calibration has been performed, the generator continuously monitors the critical internal voltages, and will not allow an exposure if certain tolerances are exceeded.

Table 3-3 shows the various voltage levels (with tolerances) that can be calibrated using this utility, and it provides the location of the test point at which a calibrated voltmeter must be connected for measuring the actual voltage level:

Table D-1. A/D Calibration Voltages

Voltage Level	Calibration Accuracy	Test Point Measurement Location
Cathode	±8 VDC	+/- bus bars on Capacitor Bank next to Power Module A19 (left side looking into generator cabinet)
Anode	±8 VDC	+/- bus bars on Capacitor Bank next to Power Module A18 (right side looking into generator cabinet)
+5VDC	±0.1 VDC	TP1 on Logic Board AY40-006S

Appendix D Calibration (Using Generator Service Tools)

Table D-1. A/D Calibration Voltages

Voltage Level	Calibration Accuracy	Test Point Measurement Location
+15VDC	±0.2 VDC	TP3 on KVP Control Board AY40-003S
-15VDC	±0.2 VDC	TP5 on KVP Control Board AY40-003S
+24VDC	±0.3 VDC	TP8 on Power Supply Board AY40-005T
Unreg. +24V (Brake)	±0.3 VDC	Terminal TB2-1 on Interface Board AY40-023T (or AY40-034T)

WARNING! The following procedure requires that power be applied to the generator. Extreme care must be exercised to ensure the safety of service or other personnel in the area.

The following procedure calibrates the generator to verify accurate system measurement of the above operating voltages. The same procedure applies to any of the voltage levels available for selection. Voltage measurement accuracy is verified using your pre-calibrated voltmeter (traceable to NIST standard) as a benchmark. Once calibrated, the generator's CPU continuously monitors these internal voltages and will terminate or not allow exposure if specified tolerances are exceeded. Proceed as follows:

1. In the Calibration Wizard - Overview tab, select the **A/D** tab (see Figure D-14). The AD Calibration Menu appears:

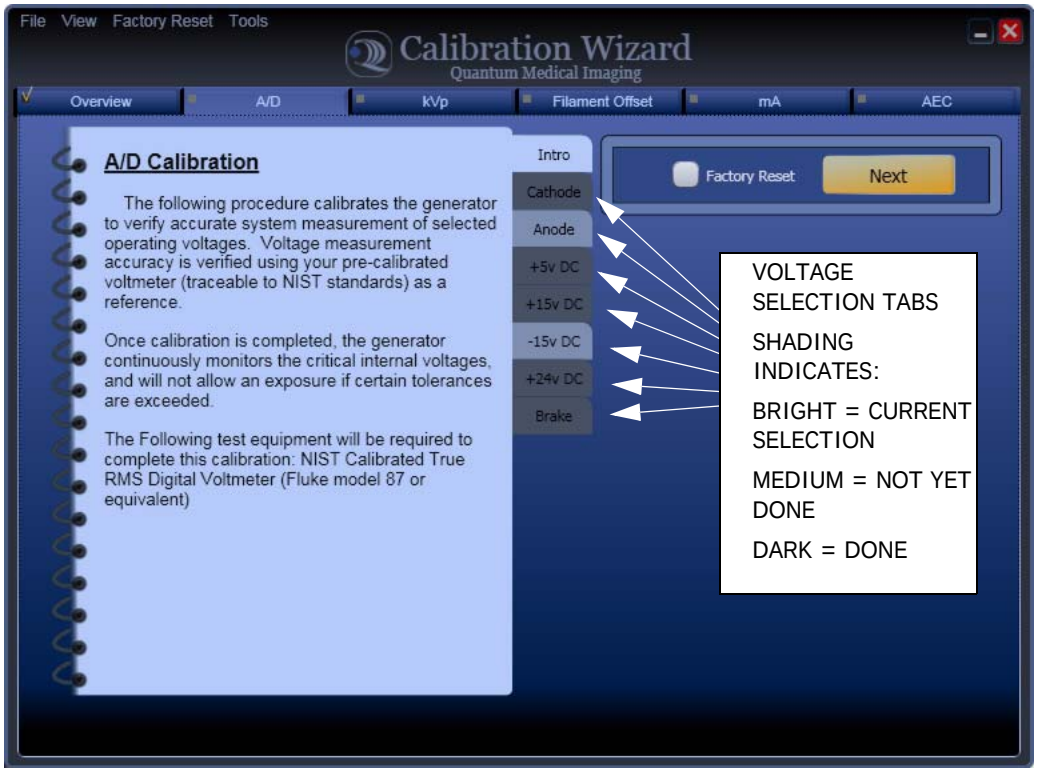

File View Factory Reset Tools
Calibration Wizard
Quantum Medical Imaging
Overview
A/D
kVp
Filament Offset
mA
AEC
A/D Calibration
The following procedure calibrates the generator to verify accurate system measurement of selected operating voltages. Voltage measurement accuracy is verified using your pre-calibrated voltmeter (traceable to NIST standards) as a reference.
Once calibration is completed, the generator continuously monitors the critical internal voltages, and will not allow an exposure if certain tolerances are exceeded.
The Following test equipment will be required to complete this calibration: NIST Calibrated True RMS Digital Voltmeter (Fluke model 87 or equivalent)
Intro
Cathode
Anode
+5v DC
+15v DC
-15v DC
+24v DC
Brake
Factory Reset
Next
VOLTAGE SELECTION TABS
SHADING INDICATES:
BRIGHT = CURRENT SELECTION
MEDIUM = NOT YET DONE
DARK = DONE

Figure D-14. Calibration Wizard - A/D Calibration Tab

2. **Factory Reset** check box - when selected, will reset all A/D Calibration values to factory default settings. This normally should not be selected; it should only be selected when calibration values are extraordinarily out-of-range (usually signifying a hardware or software abnormality).

3. Select **Next** to proceed with the first voltage calibration, or you may select a particular voltage level to calibrate by touching its corresponding tab (choices are Cathode, Anode, +5 VDC, +15 VDC, -15 VDC, +24 VDC (Regulated), and Brake (unregulated +24 VDC). For this example, "Cathode" is selected, as shown below.

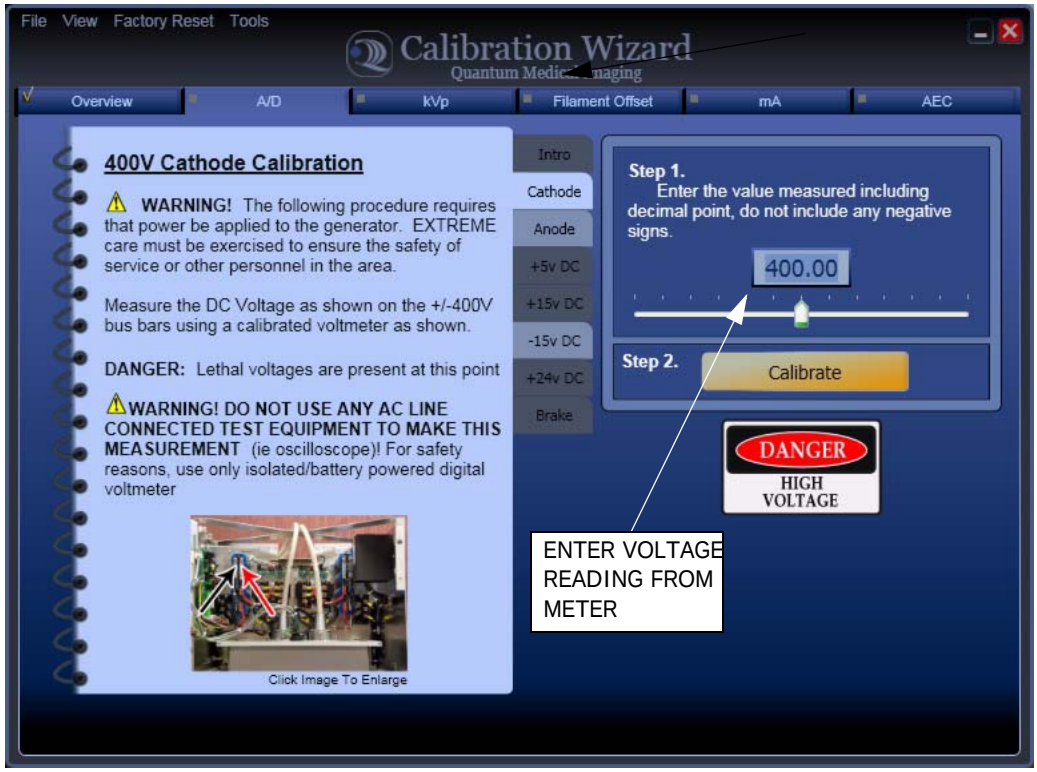

File View Factory Reset Tools
Calibration Wizard
Quantum Medical Imaging
Overview
A/D
kVp
Filament Offset
mA
AEC
400V Cathode Calibration
WARNING! The following procedure requires that power be applied to the generator. EXTREME care must be exercised to ensure the safety of service or other personnel in the area.
Measure the DC Voltage as shown on the +/-400V bus bars using a calibrated voltmeter as shown.
DANGER: Lethal voltages are present at this point
WARNING! DO NOT USE ANY AC LINE CONNECTED TEST EQUIPMENT TO MAKE THIS MEASUREMENT (ie oscilloscope)! For safety reasons, use only isolated/battery powered digital voltmeter
Click Image To Enlarge
Intro
Cathode
Anode
+5v DC
+15v DC
-15v DC
+24v DC
Brake
Step 1.
Enter the value measured including decimal point, do not include any negative signs.
400.00
Step 2.
Calibrate
DANGER
HIGH VOLTAGE
ENTER VOLTAGE READING FROM METER

Figure D-15. Sample A/D Voltage Calibration Screen (400V Cathode is shown)

4. Refer to Table D-1 and connect a voltmeter to the test point corresponding with the voltage level selected for calibration.
5. On the voltmeter, observe the measured voltage value. Enter the actual (measured) value by adjusting the slide control, or by selecting the data entry box and typing the value using a keyboard. The value entered should be to the hundredths decimal place. Press **Calibrate** button.
6. Ideally, the value appearing in the 400V Cathode Calibration Screen (Step 1.) will match the reading on the voltmeter within its allowable tolerance. If so, press the **Confirm** button. The Calibration value is saved and the system advances to the next uncalibrated A/D voltage. If not the same, press **Repeat** and re-enter the measured voltage value.

7. Repeat above steps for each of the other A/D voltage levels. Following the last A/D Calibration, the system advances to the Calibration Wizard - kVp Calibration tab.

kVp Calibration Tab

The KV Calibration procedure calibrates the generator to verify accurate system measurement of peak tube potential (kVp). The generator's ability to measure peak tube potential accurately is verified using a pre-calibrated kVp meter (Dynalyzer or equivalent) as a benchmark. Proceed as follows:

1. If not already done so, access the Calibration Wizard - kVp Calibration tab (see Figure D-16).

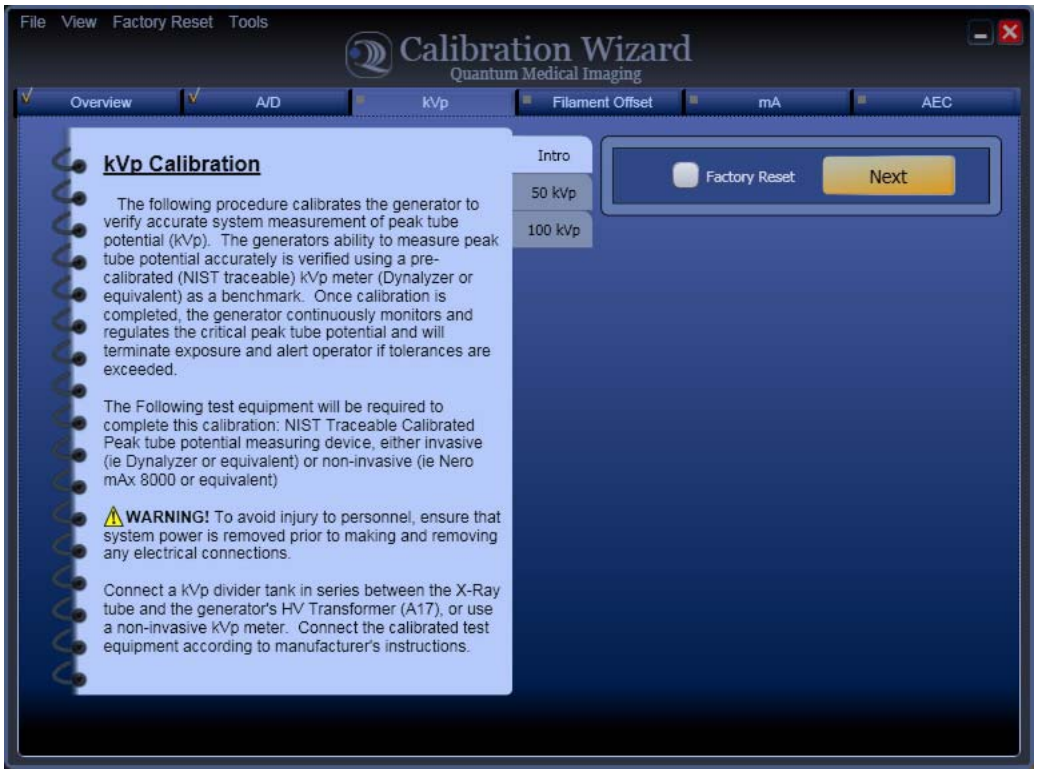

File View Factory Reset Tools
Calibration Wizard
Quantum Medical Imaging
Overview
A/D
kVp
Filament Offset
mA
AEC
kVp Calibration
The following procedure calibrates the generator to verify accurate system measurement of peak tube potential (kVp). The generators ability to measure peak tube potential accurately is verified using a pre-calibrated (NIST traceable) kVp meter (Dynalyzer or equivalent) as a benchmark. Once calibration is completed, the generator continuously monitors and regulates the critical peak tube potential and will terminate exposure and alert operator if tolerances are exceeded.
The Following test equipment will be required to complete this calibration: NIST Traceable Calibrated Peak tube potential measuring device, either invasive (ie Dynalyzer or equivalent) or non-invasive (ie Nero mAx 8000 or equivalent)
WARNING! To avoid injury to personnel, ensure that system power is removed prior to making and removing any electrical connections.
Connect a kVp divider tank in series between the X-Ray tube and the generator's HV Transformer (A17), or use a non-invasive kVp meter. Connect the calibrated test equipment according to manufacturer's instructions.
Intro
50 kVp
100 kVp
Factory Reset
Next

Figure D-16. Calibration Wizard - kVp Calibration Tab

WARNING! To avoid injury to personnel, ensure that system power is removed prior to making and removing any electrical connections.

2. **Factory Reset** check box - when selected, will reset kVp Calibration values to factory default settings. This normally should not be selected; it should only be selected when calibration values are extraordinarily out-of-range (usually signifying a hardware or software abnormality).

3. Select **Next** to proceed with the first (50) kVp calibration, or you may select a particular kVp Calibration to perform by selecting its corresponding tab (choices are 50 kVp and 100 kVp). For this example, "50 kVp" is selected, as shown below:

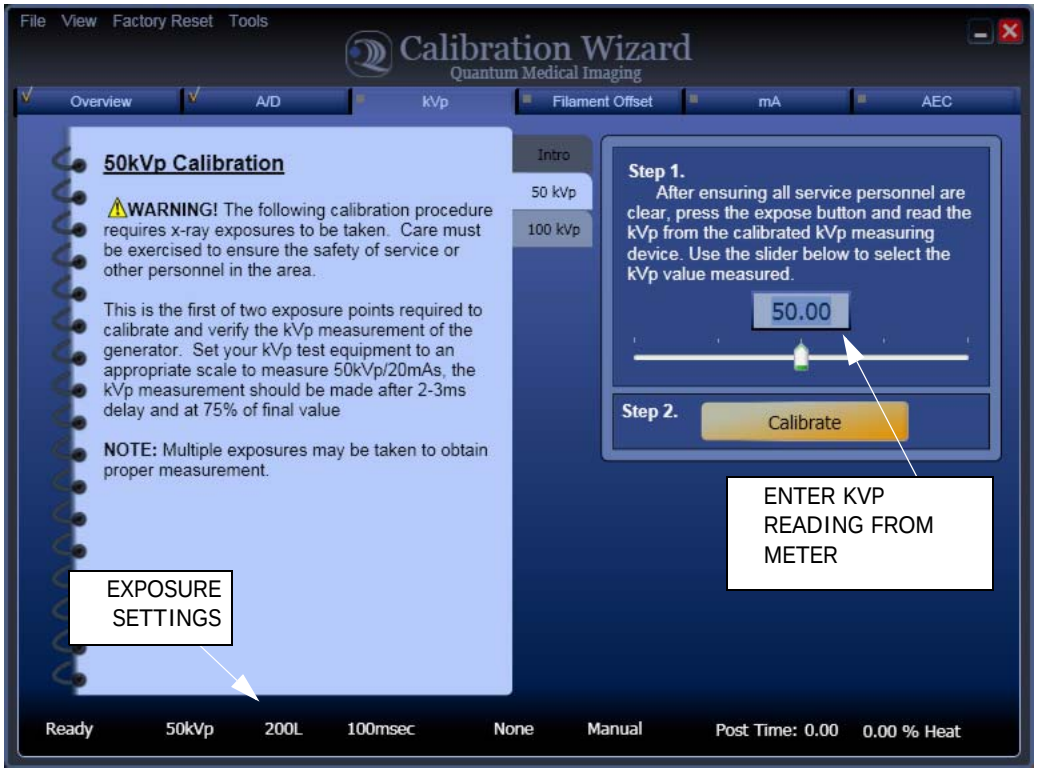

File View Factory Reset Tools
Calibration Wizard
Quantum Medical Imaging
Overview
A/D
kVp
Filament Offset
mA
AEC
50kVp Calibration
WARNING! The following calibration procedure requires x-ray exposures to be taken. Care must be exercised to ensure the safety of service or other personnel in the area.
This is the first of two exposure points required to calibrate and verify the kVp measurement of the generator. Set your kVp test equipment to an appropriate scale to measure 50kVp/20mAs, the kVp measurement should be made after 2-3ms delay and at 75% of final value
NOTE: Multiple exposures may be taken to obtain proper measurement.
Intro
50 kVp
100 kVp
Step 1.
After ensuring all service personnel are clear, press the expose button and read the kVp from the calibrated kVp measuring device. Use the slider below to select the kVp value measured.
50.00
Step 2.
Calibrate
ENTER KVP READING FROM METER
EXPOSURE SETTINGS
Ready
50kVp
200L
100msec
None
Manual
Post Time: 0.00
0.00 % Heat

Figure D-17. Sample kVp Calibration Screen (50 kVp is shown)

4. Connect a kVp bleeder tank in series between X-ray tube and the generator's H.V. Transformer (A17), or use a non-invasive kVp meter.
5. Take an exposure at the setting indicated on the 50kVp Calibration Screen (i.e., 50 kVp, 200L mA, 100 msec).
6. On the kVp meter, observe the measured kVp value. Enter the actual (measured) value by adjusting the slide control, or by selecting the data entry box and typing the value using a keyboard. The value entered should be to the hundredths decimal place. Press **Calibrate** button.
7. Ideally, the value appearing in the 50 kVp Calibration Screen (Step 1.) will match the reading on the kVp meter within allowable tolerance. If so, press the **Confirm** button. The calibration value is saved and the system advances to the 100 kVp Calibration setting.

8. If not within tolerance, press **Repeat** button, re-take the exposure at same settings and adjust kVp value as necessary. Repeat this step until indicated and measured kVp values agree to within tolerance. Press the **Confirm** button to proceed to next calibration.
9. Take an exposure at the setting indicated on the 100kVp Calibration Screen (i.e., 100 kVp, 200L mA, 100 msec).
10. On the kVp meter, observe the measured kVp value. Enter the actual (measured) value by adjusting the slide control, or by selecting the data entry box and typing the value using a keyboard. The value entered should be to the hundredths decimal place. Press **Calibrate** button.
11. Ideally, the value appearing in the 100 kVp Calibration Screen (Step 1.) will match the reading on the kVp meter within its allowable tolerance. If so, press the **Confirm** button. The calibration value is saved and the system advances to the next calibration procedure.
12. If not the same, press **Repeat** to re-take exposure and re-enter the measured kVp value.
13. Repeat kVp calibration for 100 kVp until indicated and measured kVp values agree to within tolerance. Press **Confirm** to save calibration value and to advance to next calibration procedure.

Filament Offset Calibration

This procedure establishes the filament current offset and gain corrections. Filament current measurement accuracy is verified using a pre-calibrated Dynalyzer (or equivalent), non-invasive kV meter, or mAs meter as a benchmark. Ensure precision of the measurement instrument is sufficient enough to assure generator accuracy requirements can be met. The Filament Offset Calibration procedure may be performed using an oscilloscope, however, it is not the preferred method. Using this method, the objective is to achieve the "flattest" possible large and small filament waveforms, with no spikes or peaks as shown in Figure D-18 below.

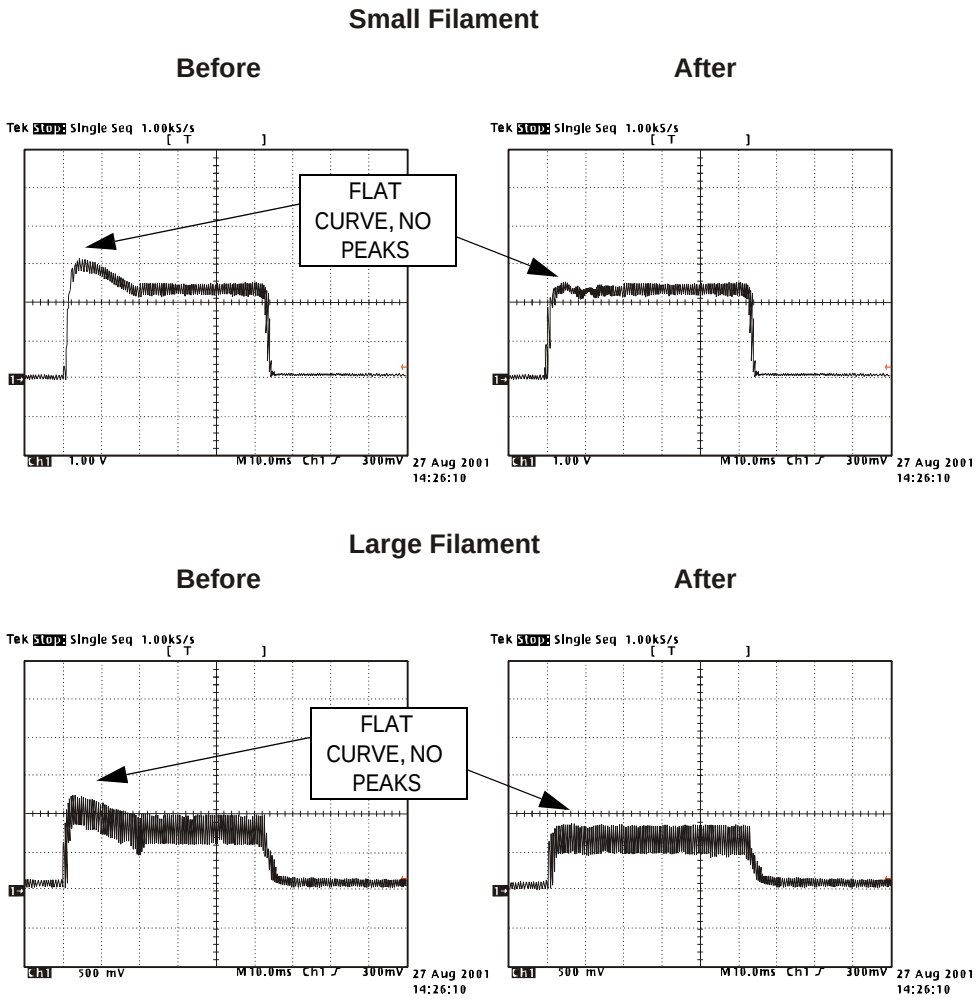


Figure D-18. Filament Offset Current Measurement (Using an Oscilloscope)

Additionally, an "Advanced Filament Calibration" wizard is provided in the Calibration Wizard program as a supplement to the standard Filament Offset Calibration. Advanced Filament Calibration is used to correct for slight

inconsistencies at specific techniques due to variations in tubes, cables, and other factors. A technique is defined as a specific combination of kVp, mA, and filament size. Advanced Filament Calibration is not required to achieve satisfactory generator performance. It should only be performed on techniques where mA accuracy improvement is required, or where mA waveform optimization is desired. This tool is discussed immediately following the standard Filament Offset calibration procedure.

Access the Filament Calibration Menu (shown below) and proceed as follows:

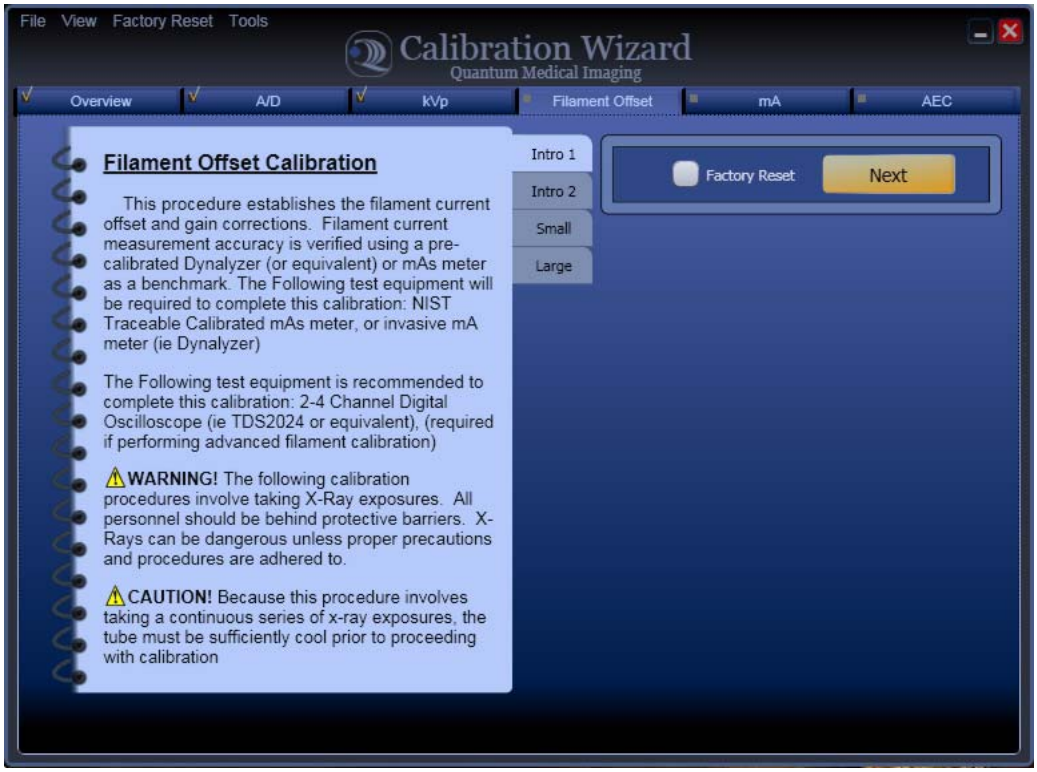

File View Factory Reset Tools
Calibration Wizard
Quantum Medical Imaging
Overview
A/D
kVp
Filament Offset
mA
AEC
Filament Offset Calibration
This procedure establishes the filament current offset and gain corrections. Filament current measurement accuracy is verified using a pre-calibrated Dynalyzer (or equivalent) or mAs meter as a benchmark. The Following test equipment will be required to complete this calibration: NIST Traceable Calibrated mAs meter, or invasive mA meter (ie Dynalyzer)
The Following test equipment is recommended to complete this calibration: 2-4 Channel Digital Oscilloscope (ie TDS2024 or equivalent), (required if performing advanced filament calibration)
WARNING! The following calibration procedures involve taking X-Ray exposures. All personnel should be behind protective barriers. X-Rays can be dangerous unless proper precautions and procedures are adhered to.
CAUTION! Because this procedure involves taking a continuous series of x-ray exposures, the tube must be sufficiently cool prior to proceeding with calibration
Intro 1
Intro 2
Small
Large
Factory Reset
Next

Figure D-19. Calibration Wizard - Filament Offset Intro 1 Tab

WARNING! To avoid injury to personnel, ensure system power is removed prior to making and removing any electrical connections.

1. **Factory Reset** check box - when selected, will reset Filament Offset Calibration values to factory default settings. This normally should not be selected; it should only be selected when calibration values are extraordinarily out-of-range (usually signifying a hardware or software abnormality).

2. Select **Next** to proceed to Filament Offset Calibration Intro 2 screen, or you may select a particular Filament Offset Calibration to perform by selecting its corresponding tab (choices are Small and Large). For this example, "Small" is selected, as shown below:

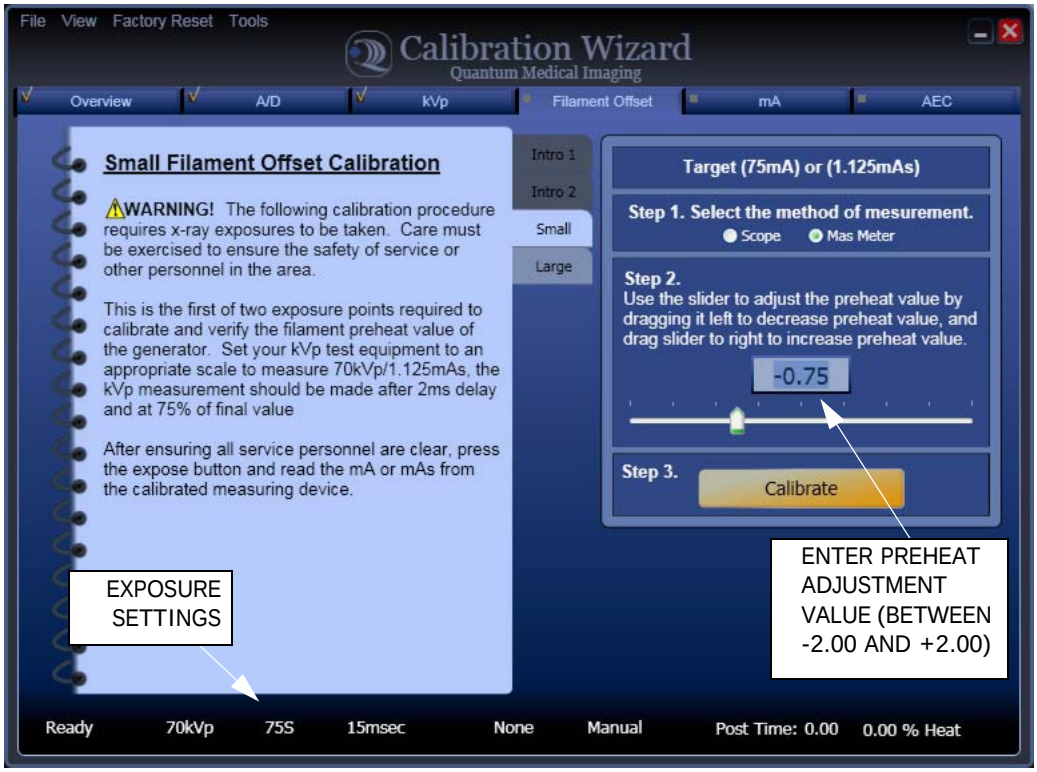

File View Factory Reset Tools
Calibration Wizard
Quantum Medical Imaging
Overview
A/D
kVp
Filament Offset
mA
AEC
Small Filament Offset Calibration
WARNING! The following calibration procedure requires x-ray exposures to be taken. Care must be exercised to ensure the safety of service or other personnel in the area.
This is the first of two exposure points required to calibrate and verify the filament preheat value of the generator. Set your kVp test equipment to an appropriate scale to measure 70kVp/1.125mAs, the kVp measurement should be made after 2ms delay and at 75% of final value
After ensuring all service personnel are clear, press the expose button and read the mA or mAs from the calibrated measuring device.
Intro 1
Intro 2
Small
Large
Target (75mA) or (1.125mAs)
Step 1. Select the method of mesurement.
Scope
Mas Meter
Step 2.
Use the slider to adjust the preheat value by dragging it left to decrease preheat value, and drag slider to right to increase preheat value.
-0.75
Step 3.
Calibrate
EXPOSURE SETTINGS
ENTER PREHEAT ADJUSTMENT VALUE (BETWEEN -2.00 AND +2.00)
Ready
70kVp
75S
15msec
None
Manual
Post Time: 0.00
0.00 % Heat

Figure D-20. Sample Filament Offset Calibration Screen (Small is shown)

3. If using an oscilloscope, select **Scope** radio button (Step 1.) on the Small Filament Offset calibration screen. Connect the scope leads between test point TP7 on KVP Control Board A2 (AY40-003S) and ground. Set scope for 1.0 volt/division, and 50 ms/division time base. This will give a 100 mA/volt equivalent for mA measurement as shown in the sample wave-forms in Figure B-20.

4. If using a mAs meter, select **Mas Meter** radio button (Step 1.) on the Small Filament Offset calibration screen. Remove two (2) green/yellow wires marked "MAS METER", connected to A17P1-9 and A17P1-10, from

the ground stud on top of the H.V. Transformer (see Figure D-21). Connect the mAs meter in series between removed wires. (*Important: These wires must be re-connected when finished calibration.*)

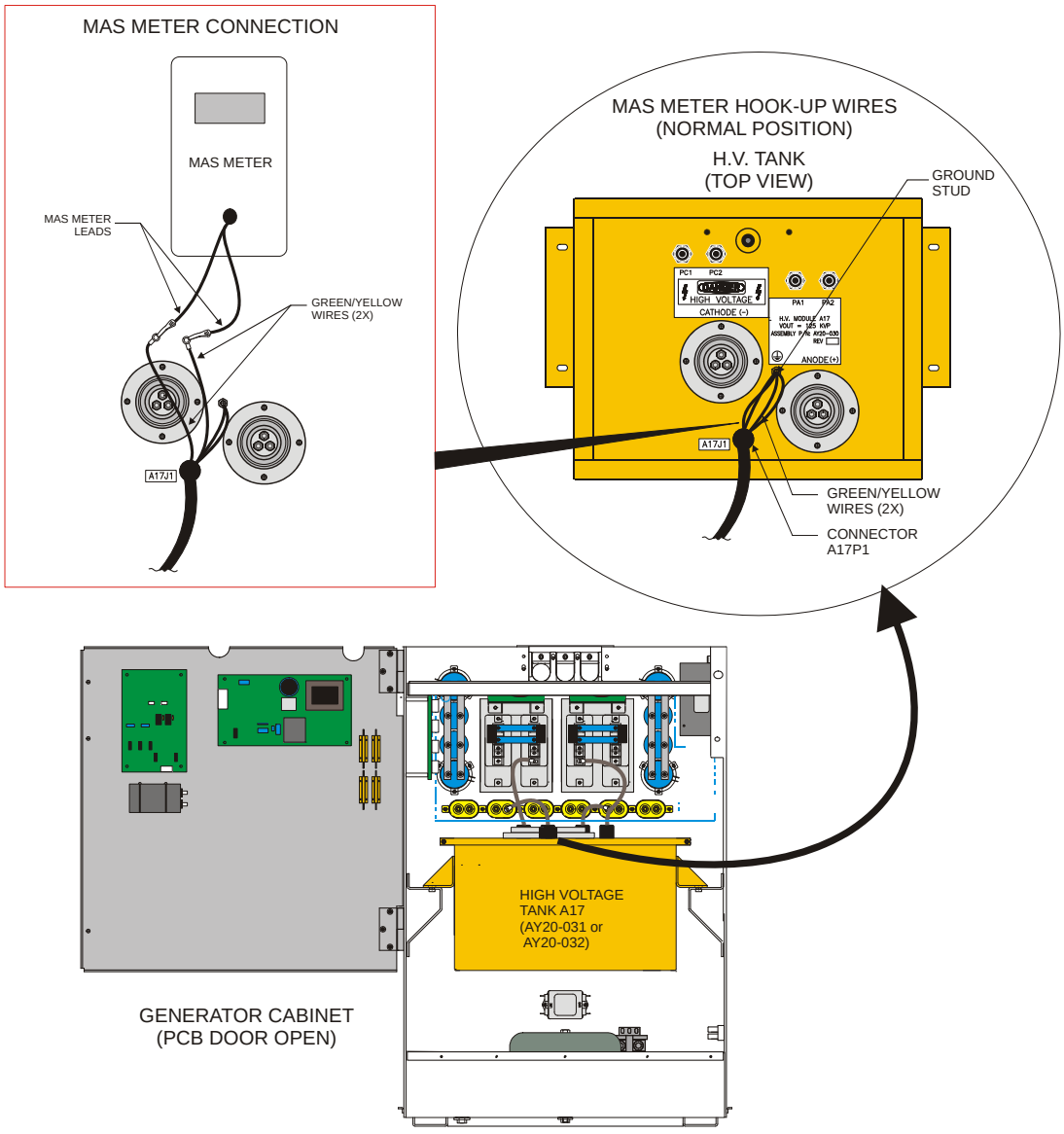


Figure D-21. MAS Meter Connection

5. Take an exposure at the setting indicated on the Small Filament Offset Calibration Screen (i.e., 70 kVp, 75s mA, 15 msec). *If using an oscilloscope, set time to 125 msec.*

6. If using an oscilloscope, observe the small filament current pulse waveform for "flatness" (see Figure D-18). If using a mAs meter, observe the measured mA value. Ideally, the mA value appearing in the Small Filament Calibration Screen (Step 1.) will match the reading on the mAs meter within allowable tolerance.
7. Press the **Calibrate** button.
8. If waveform is acceptable or if mA reading is within tolerance, press the **Confirm** button. The calibration value is saved and the system advances to the Large Filament Offset Calibration setting.
9. If mA is not within tolerance or if waveform is not flat, press the **Repeat** button.
10. Increase or decrease the preheat value displayed on the Small Filament Calibration screen (Step 2.) by adjusting the slide control, or by selecting the data entry box and typing the value using a keyboard. The value entered should be to the hundredths decimal place. The preheat value adjustment range is from +2.00 down to -2.00, with 0.00 equating to no offset applied to the tube's default filament curve. To increase mA, raise the filament offset value; to decrease mA, lower the filament offset value.

Note: An error message appears if the filament current is set too low, which indicates the filament offset value for the filament being calibrated is set too low or high. If this occurs, increase or decrease the filament current.

11. Re-take the exposure at same settings and adjust preheat value as necessary. Repeat this step until measured mA is within tolerance, or if using an oscilloscope, when waveform is sufficiently flat. Press the **Confirm** button to proceed to Large Filament Offset Calibration.

12. The Large Filament Offset Calibration screen is displayed:

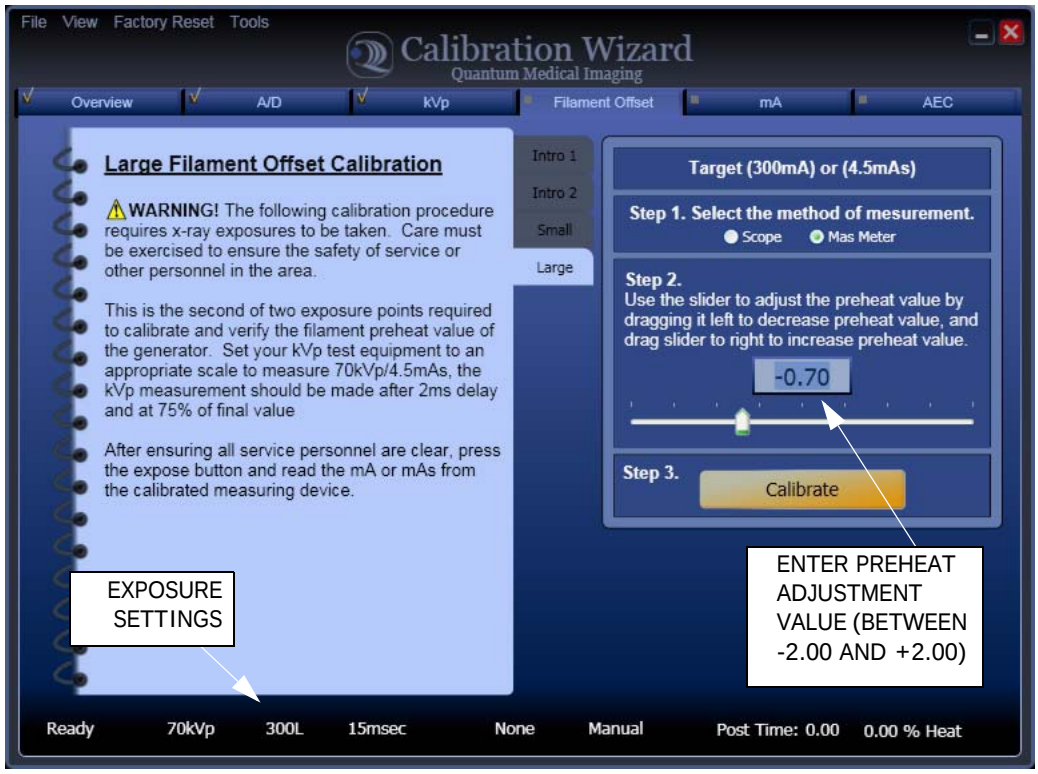

File View Factory Reset Tools
Calibration Wizard
Quantum Medical Imaging
Overview
A/D
kVp
Filament Offset
mA
AEC
Large Filament Offset Calibration
WARNING! The following calibration procedure requires x-ray exposures to be taken. Care must be exercised to ensure the safety of service or other personnel in the area.
This is the second of two exposure points required to calibrate and verify the filament preheat value of the generator. Set your kVp test equipment to an appropriate scale to measure 70kVp/4.5mAs, the kVp measurement should be made after 2ms delay and at 75% of final value
After ensuring all service personnel are clear, press the expose button and read the mA or mAs from the calibrated measuring device.
Intro 1
Intro 2
Small
Large
Target (300mA) or (4.5mAs)
Step 1. Select the method of mesurement.
Scope
Mas Meter
Step 2.
Use the slider to adjust the preheat value by dragging it left to decrease preheat value, and drag slider to right to increase preheat value.
-0.70
Step 3.
Calibrate
EXPOSURE SETTINGS
ENTER PREHEAT ADJUSTMENT VALUE (BETWEEN -2.00 AND +2.00)
Ready
70kVp
300L
15msec
None
Manual
Post Time: 0.00
0.00 % Heat

Figure D-22. Sample Filament Offset Calibration Screen (Large is shown)

13. If using an oscilloscope, select **Scope** radio button (Step 1.); if using a mAs meter, select **Mas Meter**.
14. Take an exposure at the setting indicated on the Filament Calibration Screen (i.e., 70 kVp, 300L mA (250 mA if Model QG-200-SE generator), 15 msec). *If using an oscilloscope, set time to 125 msec*.
15. If using an oscilloscope, observe the large filament current pulse waveform for "flatness" (see Figure D-18). If using a mAs meter, observe the measured mA value. Ideally, the mA value appearing in the Large Filament Calibration Screen (Step 1.) will match the reading on the mAs meter within allowable tolerance.
16. Press the **Calibrate** button.
17. If waveform is acceptable or if mA reading is within tolerance, press the **Confirm** button. The calibration value is saved and the system advances to the next calibration procedure.

18. If mA is not within tolerance or if waveform is not flat, press the **Repeat** button.
19. Increase or decrease the preheat value displayed on the Large Filament Calibration screen (Step 2.) by adjusting the slide control, or by selecting the data entry box and typing the value using a keyboard. The value entered should be to the hundredths decimal place. The preheat value adjustment range is from +2.00 down to -2.00, with 0.00 equating to no offset applied to the tube's default filament curve. To increase mA, raise the filament offset value; to decrease mA, lower the filament offset value.
20. Re-take the exposure at same settings and adjust preheat value as necessary. Repeat this step until measured mA is within tolerance, or if using an oscilloscope, when waveform is sufficiently flat. Press the **Confirm** button to proceed to next calibration procedure.

Advanced Filament Calibration Wizard

The "Advanced Filament Calibration" wizard is provided to improve system accuracy at a selectable technique (i.e., kVp, mA and filament size). Note that Advanced Filament Calibration is not required in order to achieve satisfactory generator performance. It should only be performed on techniques where mA accuracy or filament offset waveform optimization is desired.

To access the Advanced Filament Calibration wizard, proceed as follows:

1. From the Calibration Wizard screen, select **Tools**>**Advanced**>**Filament**. The Calibration Wizard - Advanced Filament Calibration Wizard Intro 1 Tab is displayed:

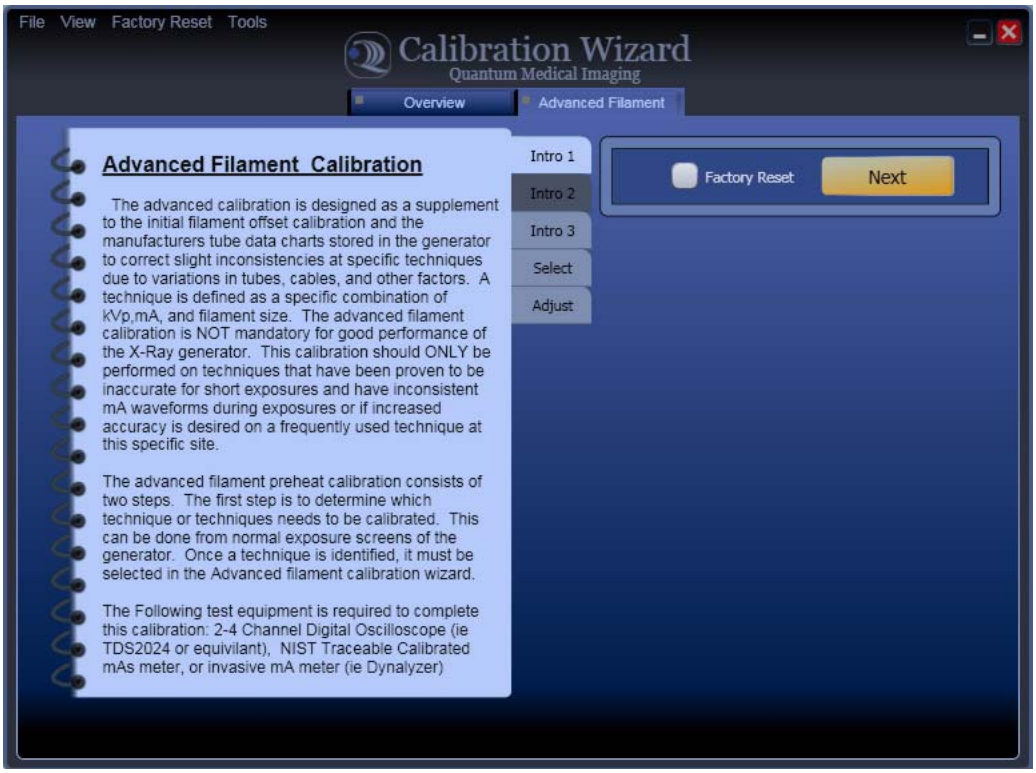

File
View
Factory Reset
Tools
Calibration Wizard
Quantum Medical Imaging
Overview
Advanced Filament
Advanced Filament Calibration
The advanced calibration is designed as a supplement to the initial filament offset calibration and the manufacturers tube data charts stored in the generator to correct slight inconsistencies at specific techniques due to variations in tubes, cables, and other factors. A technique is defined as a specific combination of kVp,mA, and filament size. The advanced filament calibration is NOT mandatory for good performance of the X-Ray generator. This calibration should ONLY be performed on techniques that have been proven to be inaccurate for short exposures and have inconsistent mA waveforms during exposures or if increased accuracy is desired on a frequently used technique at this specific site.
The advanced filament preheat calibration consists of two steps. The first step is to determine which technique or techniques needs to be calibrated. This can be done from normal exposure screens of the generator. Once a technique is identified, it must be selected in the Advanced filament calibration wizard.
The Following test equipment is required to complete this calibration: 2-4 Channel Digital Oscilloscope (ie TDS2024 or equivilant), NIST Traceable Calibrated mAs meter, or invasive mA meter (ie Dynalyzer)
Intro 1
Intro 2
Intro 3
Select
Adjust
Factory Reset
Next

Figure D-23. Calibration Wizard - Advanced Filament Calibration Wizard Intro 1 Tab

2. **Factory Reset** check box - When selected, will reset Filament Offset Calibration values to factory default settings. This normally should not be selected; it should only be selected when calibration values are extraordinarily out-of-range (usually signifying a hardware or software abnormality).

3. Select **Next** to proceed to Advanced Filament Calibration Intro 2 Tab. Per the instructions provided on this screen, connect a Digital Oscilloscope (Tektronix Model TDS2024 or equivalent) to test points TP1 (channel 1), TP7 (channel 2), and TP4 (grounds) on KVP Control Board A2 (AY40-003S) located on the generator PCB Door. Adjust the Oscilloscope settings according to the screen instructions.
4. Select **Next** to proceed to Advanced Filament Calibration Intro 3 (Waveforms) Tab. The sample filament offset waveforms illustrate three scenarios; filament offset adjusted too high, filament offset adjusted too low, and correct filament offset adjustment. Keep these in mind as you proceed through the Advanced Filament Calibration process.
5. Select **Next** to proceed to Adjustment Point Selection Tab:

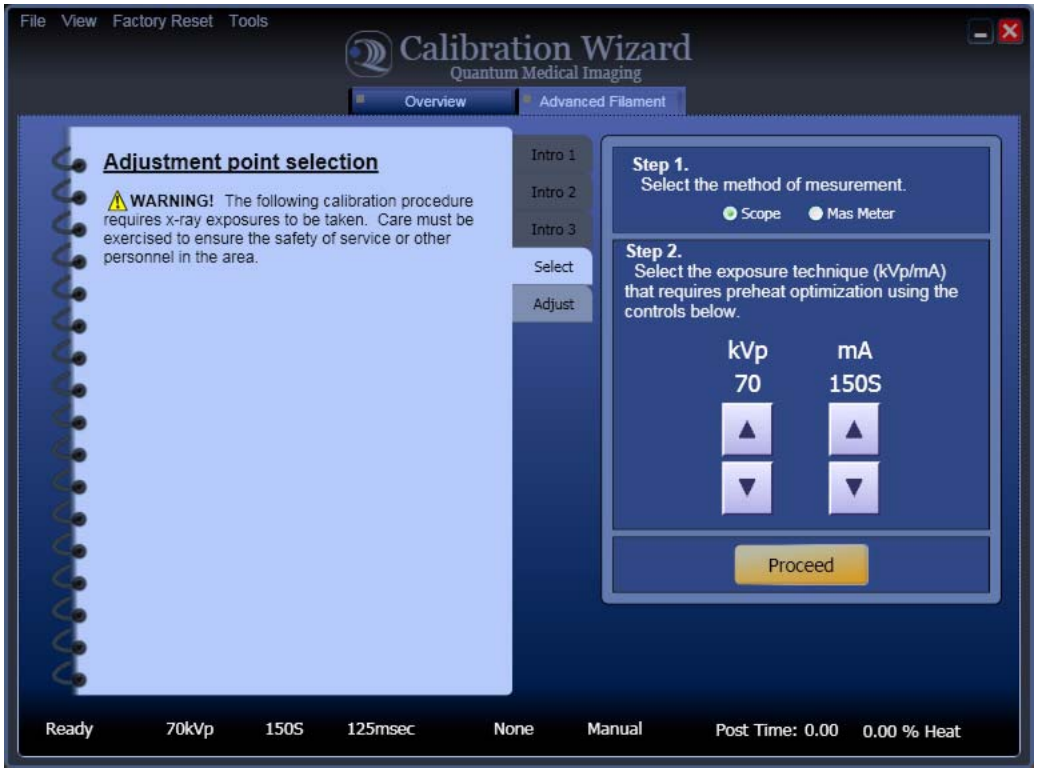


Figure D-24. Advanced Filament Calibration - Adjustment Point Selection Tab

6. If using an oscilloscope, select **Scope** radio button (Step 1.); if using a mAs meter, select **Mas Meter**.

7. Set the **kVp** and **mA** techniques to the desired values using the up/down arrow buttons, then press the **Proceed** button. The Filament Point Adjustment Tab displays:

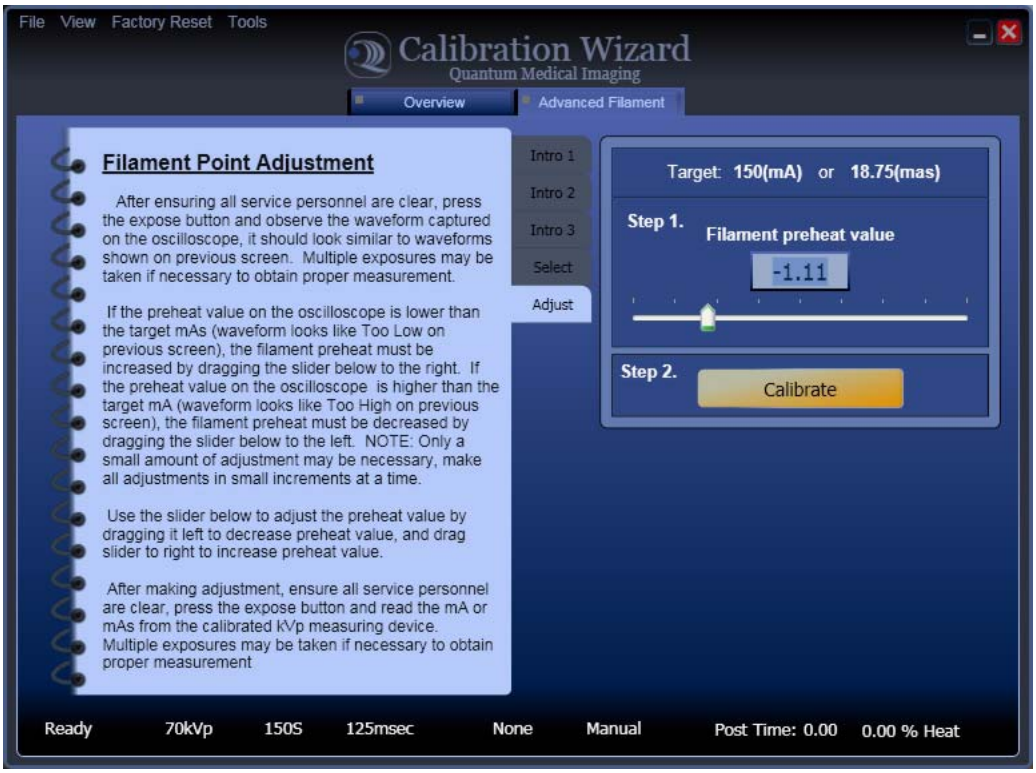

File View Factory Reset Tools
Calibration Wizard
Quantum Medical Imaging
Overview
Advanced Filament
Filament Point Adjustment
After ensuring all service personnel are clear, press the expose button and observe the waveform captured on the oscilloscope, it should look similar to waveforms shown on previous screen. Multiple exposures may be taken if necessary to obtain proper measurement.
If the preheat value on the oscilloscope is lower than the target mAs (waveform looks like Too Low on previous screen), the filament preheat must be increased by dragging the slider below to the right. If the preheat value on the oscilloscope is higher than the target mA (waveform looks like Too High on previous screen), the filament preheat must be decreased by dragging the slider below to the left. NOTE: Only a small amount of adjustment may be necessary, make all adjustments in small increments at a time.
Use the slider below to adjust the preheat value by dragging it left to decrease preheat value, and drag slider to right to increase preheat value.
After making adjustment, ensure all service personnel are clear, press the expose button and read the mA or mAs from the calibrated kVp measuring device. Multiple exposures may be taken if necessary to obtain proper measurement
Intro 1
Intro 2
Intro 3
Select
Adjust
Target: 150(mA) or 18.75(mas)
Step 1.
Filament preheat value
-1.11
Step 2.
Calibrate
Ready
70kVp
150S
125msec
None
Manual
Post Time: 0.00
0.00 % Heat

Figure D-25. Advanced Filament Calibration - Filament Point Adjustment Tab

8. Take an exposure.
9. Press the **Calibrate** button.
10. Observe the filament offset waveform captured on the oscilloscope. It should look similar to waveforms shown on the Advanced Filament Calibration Intro 3 (Waveforms) Tab.
11. If the waveform is correct, either press the **Next Point** button to select another technique to calibrate, or press the **Complete** button to exit Advanced Filament Calibration.
12. If the waveform is not correct (i.e., Too High or Too Low as shown on Advanced Filament Calibration Intro 3 (Waveforms) Tab), the filament preheat value must be adjusted using the slider control shown in Step 1 of the Filament Point Adjustment screen (see Figure D-25). If waveform is Too Low, increase the filament preheat value by mov-

ing slider to the right; if waveform is Too High, decrease the filament preheat value by moving slider to the left.

Note: Only a small amount of adjustment may be necessary, make all adjustments in small increments at a time.

13. Press the **Repeat** button.
14. Re-take the exposure and adjust preheat value if necessary. Repeat this step until mA preheat is optimized. Press **Complete** button when finished. Confirm optimization using a secondary calibrated mA measurement instrument such as Dynalyzer or mAs meter.

MA Calibration Tab

This procedure calibrates the generator to verify accurate system measurement of tube current (mA). Current measurement accuracy is verified using a pre-calibrated mAs meter (Dynalyzer or equivalent) as a benchmark. Ensure precision of the measurement instrument is sufficient enough to assure generator accuracy requirements can be met.

An oscilloscope may be used for mA measurement, however, it likely will not be precise enough to assure generator mA accuracy. To use an oscilloscope for mA measurement, connect scope leads between test point TP7 on KVP Control Board A2 (AY40-003S1) and ground. Set scope for 1.0 volt/division, and 50 ms/division time base. This will give a 100 mA/volt equivalent for mA measurement (see Figure D-26 for sample mA measurements using scope).

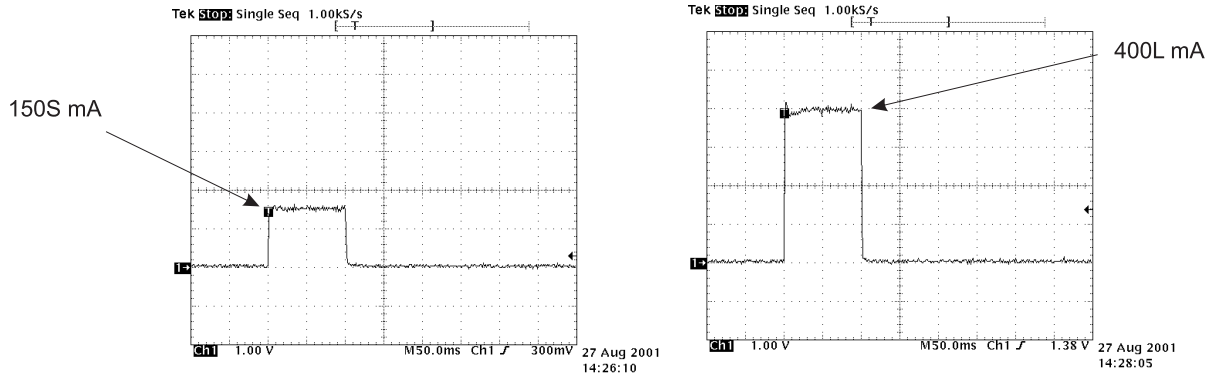

Tek Stop: Single Seq 1.00kS/s
150S mA
Ch1 1.00 V M50.0ms Ch1 300mV
27 Aug 2001
14:26:10
Example 1 - 60 kVp, 150S mA, 100 ms
Tek Stop: Single Seq 1.00kS/s
400L mA
Ch1 1.00 V M50.0ms Ch1 1.38 V
27 Aug 2001
14:28:05
Example 2 - 60 kVp, 400L mA, 100 ms

Figure D-26. MA Measurement Using an Oscilloscope

1. Access the mA Calibration Menu (shown below) and proceed as follows:

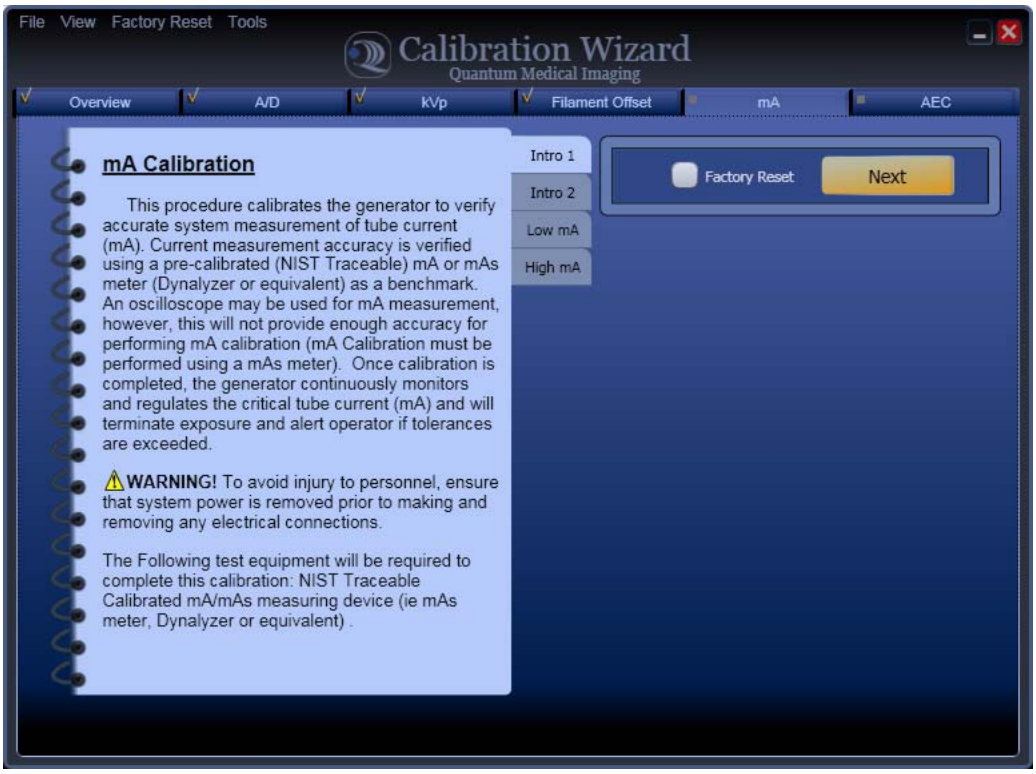

File View Factory Reset Tools
Calibration Wizard
Quantum Medical Imaging
Overview
A/D
kVp
Filament Offset
mA
AEC
mA Calibration
This procedure calibrates the generator to verify accurate system measurement of tube current (mA). Current measurement accuracy is verified using a pre-calibrated (NIST Traceable) mA or mAs meter (Dynalyzer or equivalent) as a benchmark. An oscilloscope may be used for mA measurement, however, this will not provide enough accuracy for performing mA calibration (mA Calibration must be performed using a mAs meter). Once calibration is completed, the generator continuously monitors and regulates the critical tube current (mA) and will terminate exposure and alert operator if tolerances are exceeded.
WARNING! To avoid injury to personnel, ensure that system power is removed prior to making and removing any electrical connections.
The Following test equipment will be required to complete this calibration: NIST Traceable Calibrated mA/mAs measuring device (ie mAs meter, Dynalyzer or equivalent) .
Intro 1
Intro 2
Low mA
High mA
Factory Reset
Next

Figure D-27. Calibration Wizard - mA Calibration Intro 1 Tab

WARNING! To avoid injury to personnel, ensure that system power is removed prior to making and removing any electrical connections.

2. **Factory Reset** check box - when selected, will reset mA Calibration values to factory default settings. This normally should not be selected; it should only be selected when calibration values are extraordinarily out-of-range (usually signifying a hardware or software abnormality).

3. Select **Next** to proceed to mA Calibration Intro 2 screen, or you may select a particular mA Calibration to perform by selecting its corresponding tab (choices are Low mA and High mA). For this example, "Low mA" is selected, as shown below:

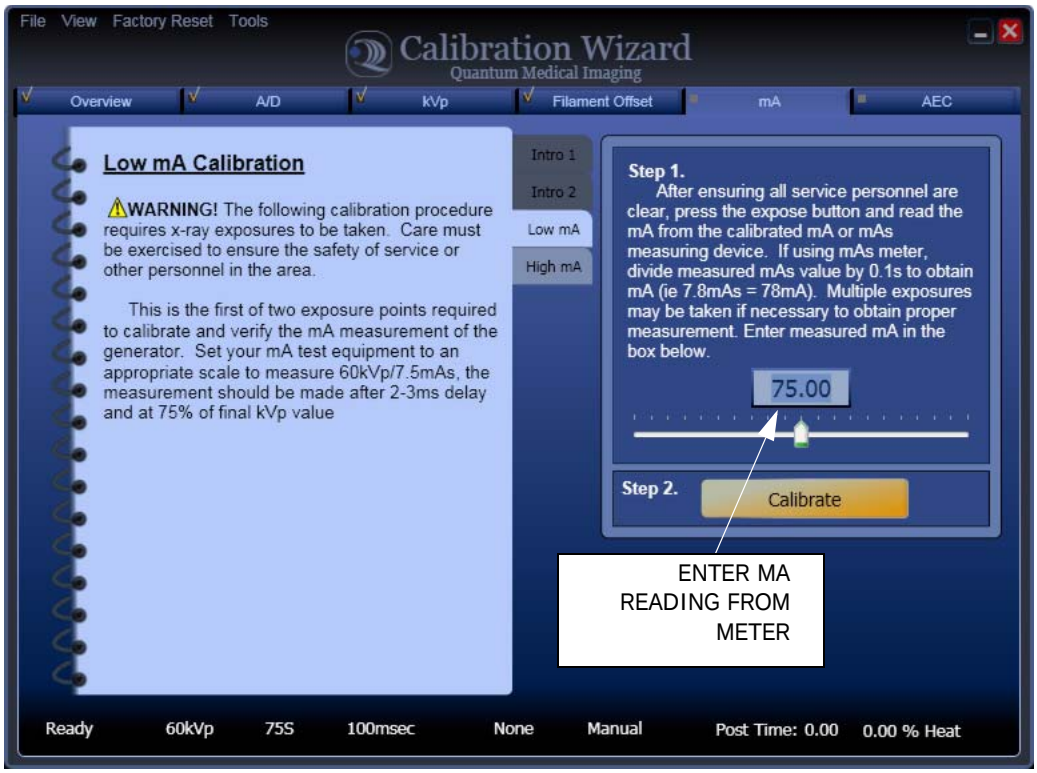

File View Factory Reset Tools
Calibration Wizard
Quantum Medical Imaging
Overview
A/D
kVp
Filament Offset
mA
AEC
Low mA Calibration
WARNING! The following calibration procedure requires x-ray exposures to be taken. Care must be exercised to ensure the safety of service or other personnel in the area.
This is the first of two exposure points required to calibrate and verify the mA measurement of the generator. Set your mA test equipment to an appropriate scale to measure 60kVp/7.5mAs, the measurement should be made after 2-3ms delay and at 75% of final kVp value
Intro 1
Intro 2
Low mA
High mA
Step 1.
After ensuring all service personnel are clear, press the expose button and read the mA from the calibrated mA or mAs measuring device. If using mAs meter, divide measured mAs value by 0.1s to obtain mA (ie 7.8mAs = 78mA). Multiple exposures may be taken if necessary to obtain proper measurement. Enter measured mA in the box below.
75.00
Step 2.
Calibrate
ENTER MA READING FROM METER
Ready
60kVp
75S
100msec
None
Manual
Post Time: 0.00
0.00 % Heat

Figure D-28. Sample mA Calibration Screen (Low mA is shown)

4. If not already done so, a kVp bleeder tank should be connected in series between tube and High-Voltage (H.V.) Transformer A17. If using a mAs meter, connect the mAs meter between pins A17P1-9 and A17P1-10 on H.V. Transformer A17. This connection is made by removing the two green/yellow wires connecting A17P1-9 and A17P1-10 to the ground stud on top of the H.V. Transformer (see Figure D-21) and connecting the removed wires to the mAs meter. (Note: The MAS meter should remain connected throughout calibration. These wires must be re-connected when finished calibration.)

5. Take an exposure at the setting indicated on the Low mA Calibration Screen (i.e., 60 kVp, 75s mA, 100 msec).

6. On the Dynalyzer Digital Display or mAs meter, observe the measured mA value. Enter the actual (measured) value into the mA field on the Low mA Calibration screen by adjusting the slide control, or by selecting the data entry box and typing the value using a keyboard. The value entered should be to the hundredths decimal place. Press **Calibrate** button.
7. Ideally, the value appearing in the Low mA Calibration Screen (Step 1.) will match the reading on the mAs meter within allowable tolerance. If so, press the **Confirm** button. The calibration value is saved and the system advances to the High mA Calibration setting.
8. If mA is not within tolerance, press **Repeat** button, re-take the exposure at same settings and re-enter the measured mA value. Repeat this step until indicated and measured mA values agree to within tolerance. Press the **Confirm** button to proceed to High mA Calibration.
9. Take an exposure at the setting indicated on the High mA Calibration Screen (i.e., 60 kVp, 400L mA (250 mA if Model QG-200-SE generator), 100 msec).
10. On the Dynalyzer Digital Display or mAs meter, observe the measured mA value. Enter the actual (measured) value into the mA field on the High mA Calibration screen by adjusting the slide control, or by selecting the data entry box and typing the value using a keyboard. The value entered should be to the hundredths decimal place. Press **Calibrate** button.
11. Ideally, the value appearing in the High mA Calibration Screen (Step 1.) will match the reading on the mAs meter within its allowable tolerance. If so, press the **Confirm** button. The calibration value is saved and the system advances to the next calibration procedure.
12. If mA is not within tolerance, press **Repeat** button, re-take the exposure at same settings and re-enter the measured mA value. Repeat this step until indicated and measured mA values agree to within tolerance. Press **Confirm** to save calibration value and to advance to next calibration procedure.

Note: The Power Supply Board's +48 VDC output may require adjusting (at potentiometer A6R17) up to +55 VDC (max.) in cases where long-length high tension cables are used and/or a heavy duty x-ray tube is installed. This can be determined by measuring the mA output (using a Dynalyzer or mAs meter) of an exposure taken at 40 to 50 kVp and the highest mA station available. The mA measured should be the same as the indicated mA (within tolerance). If mA output is low, increase the +48 VDC voltage output as required, but do not exceed +55 VDC.

CAUTION! If using a mAs meter, re-connect the green/yellow wire marked "MAS METER" to the ground stud on top of the H.V. Transformer (see Figure D-21).

AEC CALIBRATION

CAUTION! Before calibrating unit, perform warm-up procedures recommended by tube manufacturer or the warm-up procedure described in Chapter 3 of the Operator's Manual.

IMPORTANT! Before performing each AEC calibration procedure, verify the correct Film/Screen is displayed on the calibration screen (shown in top left field).

Note: In most DR or CR Film Plate systems, the entire imaging area of the digital receptor or CR Film Plate must be covered with acrylic in order to obtain accurate "S" or "REX" values used for the procedures that follow. Refer to the calibration instructions provided with digital or CR system for specific "S" or "REX" values required for AEC calibration.

The following procedures must be performed to ensure successful AEC calibration of the HF Series X-ray generator when configured as part of the QG-DIG-CXDI Integration System (i.e., integration to Canon Digital Radiography (DR) System). Table D-2 shows a summarized presentation of the AEC calibration procedure. An AEC calibration Worksheet is provided in Table D-3 for recording calibration data.

Table D-2. DR System AEC Calibration Procedure Sequence

FILM/SCREENS TO BE CALIBRATED	REQUIRED AEC CALIBRATION PROCEDURES/ SPECIAL INSTRUCTIONS
WALL72 RECEPTOR/ FILM SCREEN	1. Perform "Ion Chamber Balancing" procedure. 2. Perform "AEC MAS Balance" procedure for wall stand ion chamber. 3. Perform "Base Optical Density (OD) Calibration": a. Set desired optical density b. Set "Offset" to 1200. c. Adjust ion chamber's MASTER GAIN potentiometer until base density is achieved in acquired images. 4. Perform "AEC kVp Calibration".
WALL RECEPTOR/FILM SCREEN	1. Perform "Base Optical Density (OD) Calibration", however, **DO NOT** re-adjust the ion chamber MASTER GAIN potentiometer. Adjust "Offset" to obtain desired (set) density. 3. Perform "AEC kVp Calibration". 1. Copy "Wall72" Receptor/ Film Screen to "Wall".

Table D-2. DR System AEC Calibration Procedure Sequence

FILM/SCREENS TO BE CALIBRATED	REQUIRED AEC CALIBRATION PROCEDURES/ SPECIAL INSTRUCTIONS
TABLE RECEPTOR/FILM SCREEN	1. Perform "Ion Chamber Balancing" procedure for table ion chamber. 2. Perform "Base Optical Density (OD) Calibration": a. Set desired optical density b. Set "Offset" to 1200. c. Adjust ion chamber's MASTER GAIN potentiometer until base density is achieved in acquired images. 4. Perform "AEC kVp Calibration".

Table D-3. AEC Calibration Worksheet

Film/Screen Combination:	Table 40	Wall 40	Wall 72
BASE OD CALIBRATION			
Setting:	**50 kVp, 200L mA, 5 cm**		
Optical Density:			
Offset			
AEC kVp CALIBRATION			
Setting:	**Step 1 - 50 kVp, 200L mA, 5 cm**		
Optical Density:			
Setting:	**Step 2 - 60 kVp, 200L mA, 10 cm**		
Optical Density:			
Setting:	**Step 3 - 80 kVp, 200L mA, 15 cm**		
Optical Density:			
Setting:	**Step 4 - 100 kVp, 200L mA, 20 cm**		
Optical Density:			
Setting:	**Step 5 - 110 kVp, 200L mA, 25 cm**		
Optical Density:			
Setting:	**Step 6 - 120 kVp, 200L mA, 30 cm**		
Optical Density:			
Setting:	***Step 7 - 130 kVp, 200L mA, 30 cm**		
Optical Density:			
Setting:	***Step 8 - 140 kVp, 200L mA, 30 cm**		
Optical Density:			

* Only required on 150 kVp systems

Ion Chamber Balancing (Three-field Chambers)

On systems using a three-field ion chamber, the chamber detectors must be balanced prior to performing AEC calibration (refer to the ion chamber manufacturer's instruction manual). When balanced, the mAs will be approximately the same (±5%) for exposures taken using any of the three chambers, or with two or more chambers selected simultaneously. This procedure must be performed on each ion chamber used in the system (for example, both table and wall ion chambers when equipped with two). Before proceeding, check that the ion chamber detectors have been correctly configured so when the chamber select buttons on the operator control panel are pressed, the appropriate ion chamber detector is enabled. If not, refer to

"Ion Chamber Tab" configuration procedure described previously in this appendix and re-configure. Proceed as follows:

1. If not already done so, a kVp bleeder tank should be connected in series between tube and High-Voltage (H.V.) Transformer A17. If using a mAs meter, connect the mAs meter between pins A17P1-9 and A17P1-10 on H.V. Transformer A17.
2. Access Generator Settings Screen (see Figure D-4). Make a note of the Backup MAS setting, then change the Backup MAS to "40".
3. Press the Manual/AEC Mode button on the operator control panel and select AEC mode.
4. Using a lead sheet, cover the UPPER RIGHT and CENTER ion chamber detectors.
5. Place 20 CM acrylic over UPPER LEFT ion chamber detector.
6. Set operator control panel for 100 KV, 200L MA, select the UPPER LEFT ion chamber detector and take an exposure. Note the measured mAs reading.
7. Repeat above steps with the CENTER ion chamber detector selected and UPPER LEFT and UPPER RIGHT detectors covered with lead. The measured mAs reading should be within 5% of the mAs reading noted in the previous step. If not, adjust the CENTER detector gain potentiometer located on the ion chamber amplifier (refer to ion chamber manufacturer's documentation for details), then re-take exposure and verify it is within tolerance. Repeat as necessary.

Note: If the system is equipped with "universal" type AEC (i.e., AEC Board A11 is part number AY40-027S), and the ion chamber is "level" type (i.e., Siemens), adjust the appropriate detector gain potentiometer on AY40-027S in accordance with the table below:

Table D-4. Universal AEC Board A11 Detector Gain Adjustment Potentiometers (Siemens Ion Chamber Only)

ION CHAMBER	DETECTOR	AEC BOARD A11 (AY40-027S) POTENTIOMETER
TABLE	1	R61
TABLE	2	R63
TABLE	3	R66
WALL#1	1	R54
WALL#1	2	R55
WALL#1	3	R56
WALL#2	1	R53
WALL#2	2	R58
WALL#2	3	R57

8. Repeat above steps with UPPER RIGHT ion chamber detector selected and UPPER LEFT and UPPER CENTER detectors covered with lead. The measured mAs reading should be within 5% of the mAs reading noted in the previous step. If not, adjust the UPPER RIGHT detector gain potentiometer, re-take exposure and verify it is within tolerance. Repeat as necessary.
9. Access the Generator Settings Screen and reset Backup MAS to original setting noted previously.

AEC MAS Balance Verification

The generator AEC mAs balance was pre-calibrated at the factory. However, verification of AEC mAs balance assures AEC calibration accuracy. When balanced, the mAs at the specified exposures will be approximately the same (±6%). This procedure only needs to be performed once prior to AEC calibration of the film/screen combination(s) used with the system. Proceed as follows:

1. If not already done so, connect a kVp bleeder tank in series between tube and High-Voltage (H.V.) Transformer A17. If using a mAs meter, connect the mAs meter between pins A17P1-9 and A17P1-10 on H.V. Transformer A17. This connection is made by removing the two green/yellow wires connecting A17P1-9 and A17P1-10 to the ground stud on top of the H.V. Transformer (see Figure D-21) and connecting the removed wires to the mAs meter. (Note: These wires must be re-connected when finished calibration.)
2. Place 20 cm of acrylic in the X-ray beam. (Where practical, adjust acrylic thickness to obtain approximately 100 millisecond exposures.)
3. If calibrating a" level" type ion chamber, ensure all three ion chamber detectors are selected.
4. Press the Manual/AEC Mode button on the operator control panel and select enter AEC mode.
5. Set the operator control panel for 110 kVp (100 kVp if calibrating a "level" type (Siemens) ion chamber - requires AY40-027S AEC board), 75S mA and take an exposure.
6. On the Dynalyzer Digital Display or mAs meter, note the measured mAs value.
7. Set the operator control panel for 110 kVp (100 kVp if calibrating a "level" type (Siemens) ion chamber - requires AY40-027S AEC board) and the highest available mA station. Take an exposure.
8. On the Dynalyzer Digital Display or mAs meter, note the measured mAs value.
9. The mAs values noted must be within ±5%. If not, adjustment of the dV/dt potentiometer on AEC Board A11 is necessary:
    - If the generator is equipped with "standard" type AEC (i.e., AEC Board A11 is part number AY40-031S), adjust potentiometer A11R12 to increase or decrease the mAs value.

- If the generator is equipped with "universal" type AEC (i.e., AEC Board A11 is part number AY40-027S), and the ion chamber is "level" type (i.e., Siemens), adjust potentiometer A11R82 to increase or decrease the mAs value.
- If the generator is equipped with "universal" type AEC (i.e., AEC Board A11 is part number AY40-027S), and the ion chamber is "slope" type (i.e., AID), adjust potentiometer A11R87 to increase or decrease the mAs value.

10. Re-take exposure at the above settings. Repeat until the two measured values are within range.
11. Take an exposure at 110 kVp (100 kVp if calibrating a "level" type (Siemens) ion chamber), 75S mA, 10 cm. Verify mAs value is within ±5% of previous measurements.
12. Take an exposure at 110 kVp (100 kVp if calibrating a "level" type (Siemens) ion chamber), a mid-range mA value, 10 cm. Verify mAs value is within ±5% of previous measurements.

CAUTION! If using a mAs meter, re-connect the green/yellow wire marked "MAS METER" to the ground stud on top of the H.V. Transformer (see Figure D-21).

The AEC Calibration Tab

WARNING! The following calibration procedures involve taking x-ray exposures. All personnel should be behind the protective barriers. X-rays can be dangerous unless proper precautions and procedures are adhered to.

Access the AEC Calibration menu (shown below) and proceed as follows:

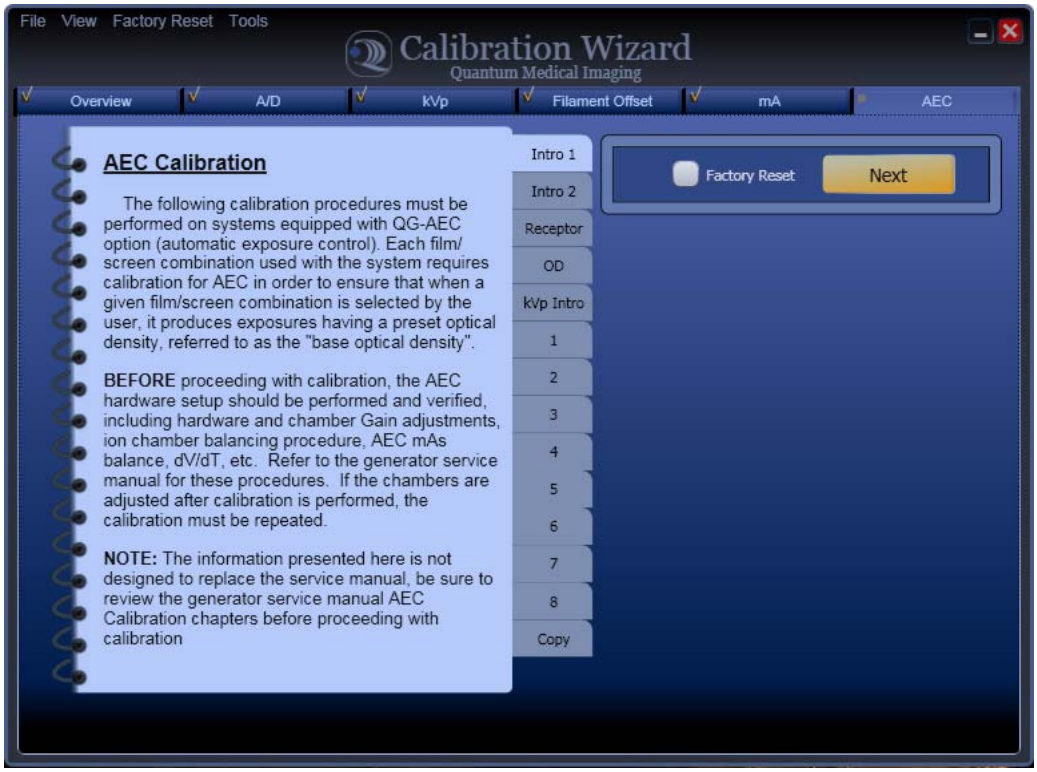

File View Factory Reset Tools
Calibration Wizard
Quantum Medical Imaging
Overview
A/D
kVp
Filament Offset
mA
AEC
AEC Calibration
The following calibration procedures must be performed on systems equipped with QG-AEC option (automatic exposure control). Each film/screen combination used with the system requires calibration for AEC in order to ensure that when a given film/screen combination is selected by the user, it produces exposures having a preset optical density, referred to as the "base optical density".
BEFORE proceeding with calibration, the AEC hardware setup should be performed and verified, including hardware and chamber Gain adjustments, ion chamber balancing procedure, AEC mAs balance, dV/dT, etc. Refer to the generator service manual for these procedures. If the chambers are adjusted after calibration is performed, the calibration must be repeated.
NOTE: The information presented here is not designed to replace the service manual, be sure to review the generator service manual AEC Calibration chapters before proceeding with calibration
Intro 1
Intro 2
Receptor
OD
kVp Intro
1
2
3
4
5
6
7
8
Copy
Factory Reset
Next

Figure D-29. Calibration Wizard - AEC Calibration Intro 1 Tab

The AEC Calibration menu provides access to the system's various AEC calibration functions, briefly described as follows:

- Receptor - Provides for selection of a Receptor/Film Screen for AEC calibration
- Optical Density - Calibrates the currently selected Receptor/Film Screen and ion chamber combination to a user-selectable, base optical density (gray level) setting. This target level, referred to as the "Base OD setting", determines the basic "gray-level" quality of images acquired in AEC mode

- KV - Calibrates the tube voltage settings used in conjunction with a particular Receptor/Film Screen and ion chamber combination
- Copy - The Copy Receptor Calibration utility enables stored AEC calibration data (kV curves, AEC offset data) to be copied from a calibrated receptor/film screen to another receptor/film screen in order to reduce overall calibration time.

IMPORTANT! When calibrating AEC using a wall stand mounted receptor, ensure that the x-ray beam is perpendicular to image receptor and that the correct ion chamber detector(s) is selected.

Proceed as follows:

1. **Factory Reset** check box - when selected, will reset AEC Calibration values to factory default settings. This normally should not be selected; it should only be selected when calibration values are extraordinarily out-of-range (usually signifying a hardware or software abnormality).

2. Select **Next** to proceed to AEC Calibration Intro 2 screen, or you may select a particular AEC Calibration to perform by selecting its corresponding tab (choices are Receptor, OD, kVp Intro and kVp calibration steps 1 through 8, and Copy). For this example, "Receptor" is selected, as shown below:

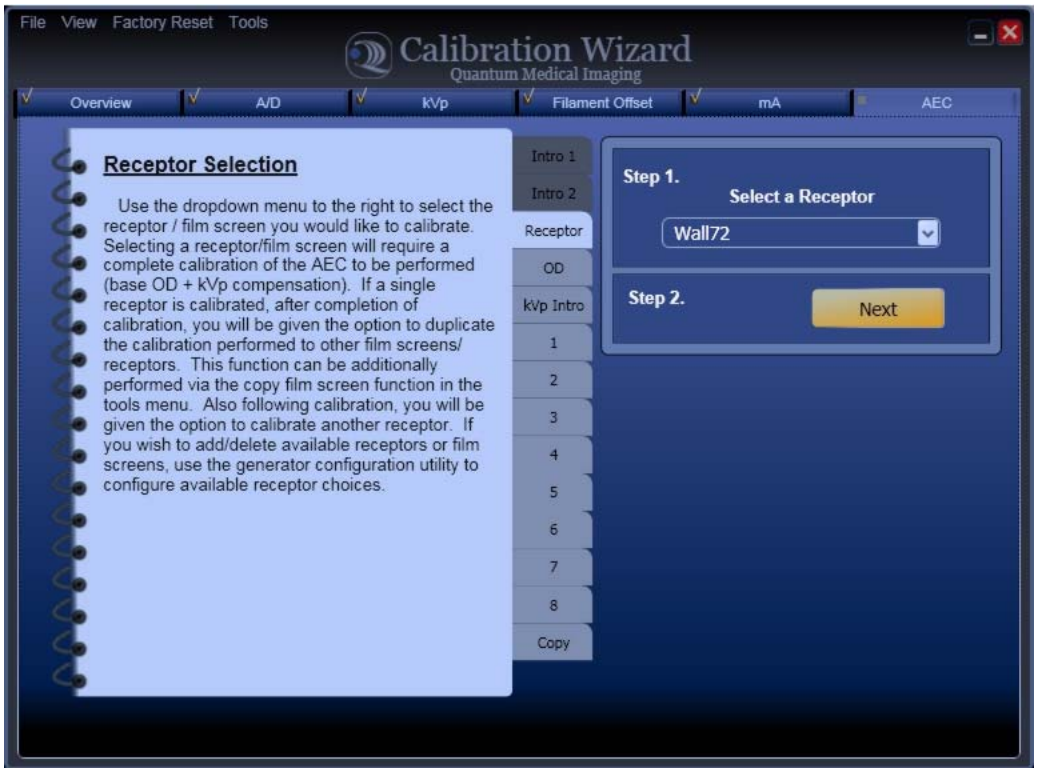

File View Factory Reset Tools
Calibration Wizard
Quantum Medical Imaging
Overview
A/D
kVp
Filament Offset
mA
AEC
Receptor Selection
Use the dropdown menu to the right to select the receptor / film screen you would like to calibrate. Selecting a receptor/film screen will require a complete calibration of the AEC to be performed (base OD + kVp compensation). If a single receptor is calibrated, after completion of calibration, you will be given the option to duplicate the calibration performed to other film screens/ receptors. This function can be additionally performed via the copy film screen function in the tools menu. Also following calibration, you will be given the option to calibrate another receptor. If you wish to add/delete available receptors or film screens, use the generator configuration utility to configure available receptor choices.
Intro 1
Intro 2
Receptor
OD
kVp Intro
1
2
3
4
5
6
7
8
Copy
Step 1.
Select a Receptor
Wall72
Step 2.
Next

Figure D-30. Calibration Wizard - AEC Calibration Intro 1 Tab

Note: Each physical receptor used with the generator is configurable for use with a particular Receptor/Film Screen using the Receptors Configuration utility described previously in the Configuration section of this appendix (see Figure D-8).

3. Select a Receptor/Film Screen to calibrate (touch or click on the down arrow at the right end of receptor field to display additional choices). For this example, "Wall72" is selected. Press **Next** button.

4. The Calibration Wizard - Base Optical Density (OD) Calibration screen appears:

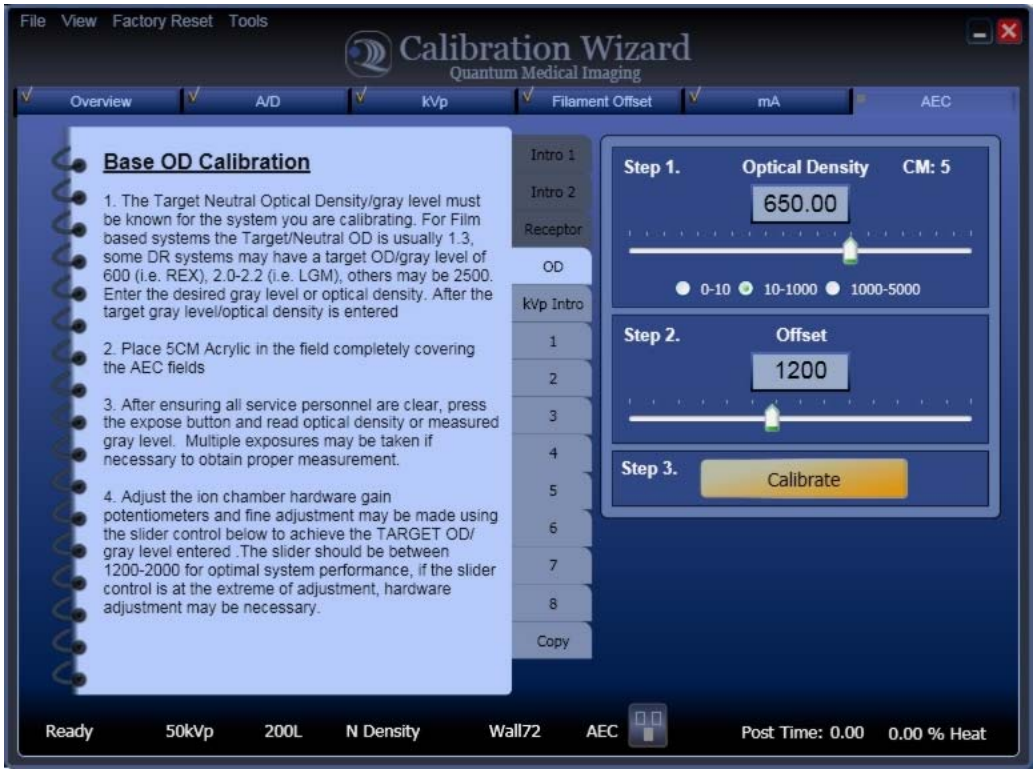

File View Factory Reset Tools
Calibration Wizard
Quantum Medical Imaging
Overview
A/D
kVp
Filament Offset
mA
AEC
Base OD Calibration
1. The Target Neutral Optical Density/gray level must be known for the system you are calibrating. For Film based systems the Target/Neutral OD is usually 1.3, some DR systems may have a target OD/gray level of 600 (i.e. REX), 2.0-2.2 (i.e. LGM), others may be 2500. Enter the desired gray level or optical density. After the target gray level/optical density is entered
2. Place 5CM Acrylic in the field completely covering the AEC fields
3. After ensuring all service personnel are clear, press the expose button and read optical density or measured gray level. Multiple exposures may be taken if necessary to obtain proper measurement.
4. Adjust the ion chamber hardware gain potentiometers and fine adjustment may be made using the slider control below to achieve the TARGET OD/ gray level entered .The slider should be between 1200-2000 for optimal system performance, if the slider control is at the extreme of adjustment, hardware adjustment may be necessary.
Intro 1
Intro 2
Receptor
OD
kVp Intro
1
2
3
4
5
6
7
8
Copy
Step 1.
Optical Density
CM: 5
650.00
0-10
10-1000
1000-5000
Step 2.
Offset
1200
Step 3.
Calibrate
Ready
50kVp
200L
N Density
Wall72
AEC
Post Time: 0.00
0.00 % Heat

Figure D-31. Calibration Wizard - Base OD Tab

Base OD Calibration Procedure

Note: When calibrating the first Receptor/Film Screen, set the "Offset" value to 1200, and adjust the MASTER GAIN potentiometer on the ion chamber until the desired target density is obtained.

Note: If the system is equipped with "standard type" AEC Board A11 (AY40-031S), the "Table Gain Adj. Potentiometer" is A11R22 and the "Wall Gain Adj. Potentiometer" is A11R23. If the system is equipped with "Universal type" AEC Board A11 (AY40-027S), the "Table Gain Adj. Potentiometer" is A11R77 and the "Wall Gain Adj. Potentiometer" is A11R79.

If the selected film/screen combination is the first one to be calibrated with the system, perform the following steps:

1. Set the ion chamber detector selection to middle detector and ensure x-ray tube is at correct SID. Ensure the ion chamber has been balanced.
2. Set the Optical Density to the desired target level (e.g., "650.00" as shown in Figure D-31). To do so, set the OD range (located directly below "Optical Density" field) for **10-1000**. Enter the Optical Density value by adjusting the slide control, or by selecting the data entry box and typing the value using a keyboard. The value entered should be to the hundreths decimal place. *Do not change the Target Level setting at any time during this procedure.*
3. Set the Offset value displayed on the Base OD Calibration screen (Step 2.) to "1200" by adjusting the slide control, or by selecting the data entry box and typing the value using a keyboard. The Offset value adjustment range is from 500 to 4000.
4. Place 5 cm of acrylic in the X-ray beam completely covering the ion chamber detectors.
5. Take an exposure at the setting indicated on the Base OD Calibration Screen (i.e., 50 kVp, 200L mA, normal density).
6. On film systems, develop the film and then measure its optical density. On CR or DR systems, observe the density level displayed on the integrated system's workstation computer.
7. Press the **Calibrate** button.
8. If the density value is within acceptable range of the Target Level (on CR or DR systems, refer to manufacturer's specifications), press the **Confirm** button to save the setting and proceed to AEC kVp Calibration.

NOTE

The series of AEC optical density measurements should be repeated as many times as required until optical density is sufficiently accurate to meet regulatory and facility requirements.

9. If not within range, press **Repeat** button and perform the following adjustments:

    a. Adjust Table Gain Adj. potentiometer (if calibrating the table receptor) or Wall Gain Adj. potentiometer (if calibrating the wall receptor), and re-take exposure. Continue until the measured density value equals the Target Level setting to within DR System manufacturer's specification.

    b. If you still cannot achieve the Target Level setting, set Table Gain Adj. potentiometer (if calibrating the table receptor) or Wall Gain Adj. potentiometer (if calibrating the wall receptor) to mid-range, then adjust the ion chamber's MASTER GAIN potentiometer until roughly the desired density is obtained. Further fine-tuning can then be achieved by adjusting the Table or Wall Gain Adj. potentiometer as described in the previous step.

    c. If the measured density value still does not equal the Target Level setting even with the ion chamber's MASTER GAIN potentiometer set to maximum gain position, increase gain of each chamber detector and perform the "AEC MAS Balance Verification" procedure. Repeat Base OD calibration.

    d. If the measured density value still does not equal the Target Level setting after adjusting the MASTER GAIN and gain of individual detectors, reduce the Offset value until the desired density value is obtained.

If the selected Receptor/Film Screen is not the first one to be calibrated with the system, perform the following steps:

1. Set the "Target Level" to the desired level (e.g., "650.00" as shown in Figure D-31). To do so, set the OD range (located directly below "Optical Density" field) for **10-1000**. Enter the Optical Density value by adjusting the slide control, or by selecting the data entry box and typing the value using a keyboard. The value entered should be to the hundreths decimal place. *Do not change the Target Level setting at any time during this procedure.*

2. Place 5 CM of acrylic in the X-ray beam completely covering the ion chamber detectors.

3. Take an exposure at the setting indicated on the Base OD Calibration Screen (i.e., 50 kVp, 200L mA, normal density).

4. On film systems, develop the film and then measure its optical density. On CR or DR systems, observe the density level displayed on the integrated system's workstation computer.

5. If the density value is within acceptable range of the Target Level (on CR or DR systems, refer to manufacturer's specifications), press the **Calibrate** button to save the setting and proceed to AEC kVp Calibration.

6. If density value is too low, decrease the Offset value displayed on the Base OD Calibration screen (Step 2.) by adjusting the slide control, or by selecting the data entry box and typing the value using a keyboard. The Offset value adjustment range is from 500 to 4000. Increase or decrease the Offset value as required, then press **Calibrate**.
7. Press **Repeat** button to re-take exposure.
8. Continue until the measured density value equals the Target Level optical density setting to within DR System manufacturer's specification. When it does, press **Confirm** button. The system advances to AEC kVp Calibration.

AEC kVp Calibration Procedure

The AEC KV Calibration screen (shown below) is used to calibrate the tube voltage to the Base (Target Level) optical density setting. There are a total of six kV calibration points for a 125 kV system (50, 60, 80, 100, 110, and 120 kV); 150 kV systems require an additional two kV calibration points (130 and 140 kV). The image receptor and chamber field settings remain the same as those used in the Base OD Calibration procedure described previously.

1. Access the AEC kVp Calibration Tab (shown below) and proceed as follows.

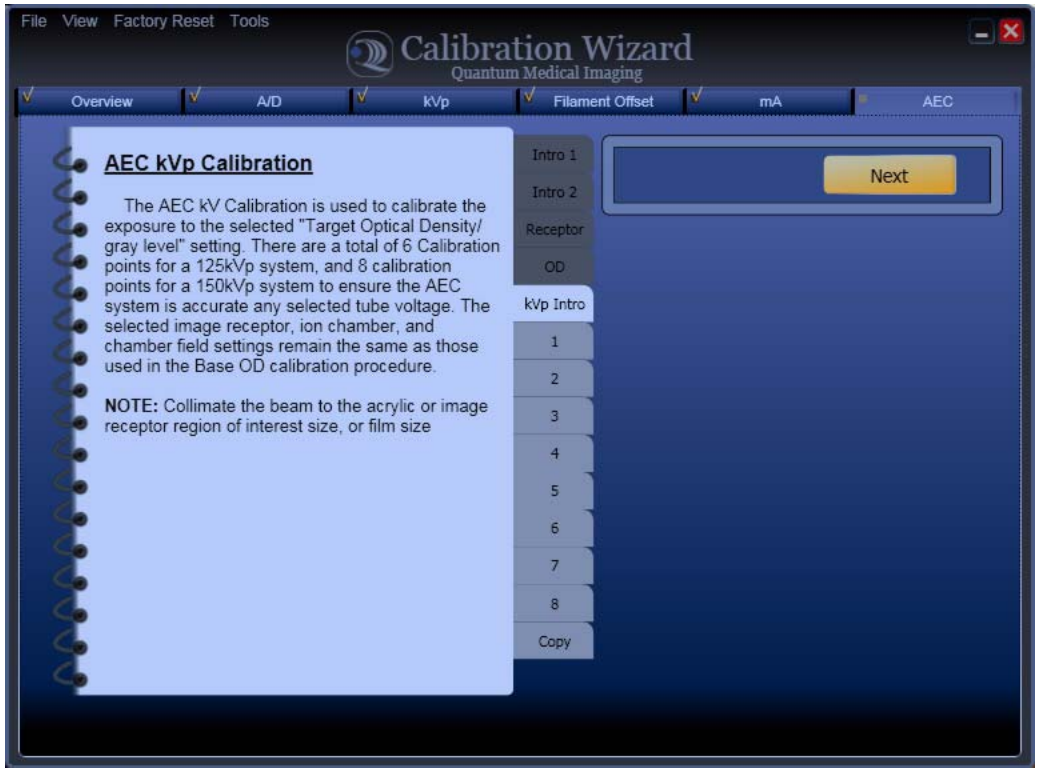

File View Factory Reset Tools
Calibration Wizard
Quantum Medical Imaging
Overview
A/D
kVp
Filament Offset
mA
AEC
AEC kVp Calibration
The AEC kV Calibration is used to calibrate the exposure to the selected "Target Optical Density/ gray level" setting. There are a total of 6 Calibration points for a 125kVp system, and 8 calibration points for a 150kVp system to ensure the AEC system is accurate any selected tube voltage. The selected image receptor, ion chamber, and chamber field settings remain the same as those used in the Base OD calibration procedure.
NOTE: Collimate the beam to the acrylic or image receptor region of interest size, or film size
Intro 1
Intro 2
Receptor
OD
kVp Intro
1
2
3
4
5
6
7
8
Copy
Next

Figure D-32. Calibration Wizard - AEC kVp Calibration Tab

2. Press the **Next** button to proceed. The Calibration Wizard - 50 kVp 5cm Calibration screen displays:

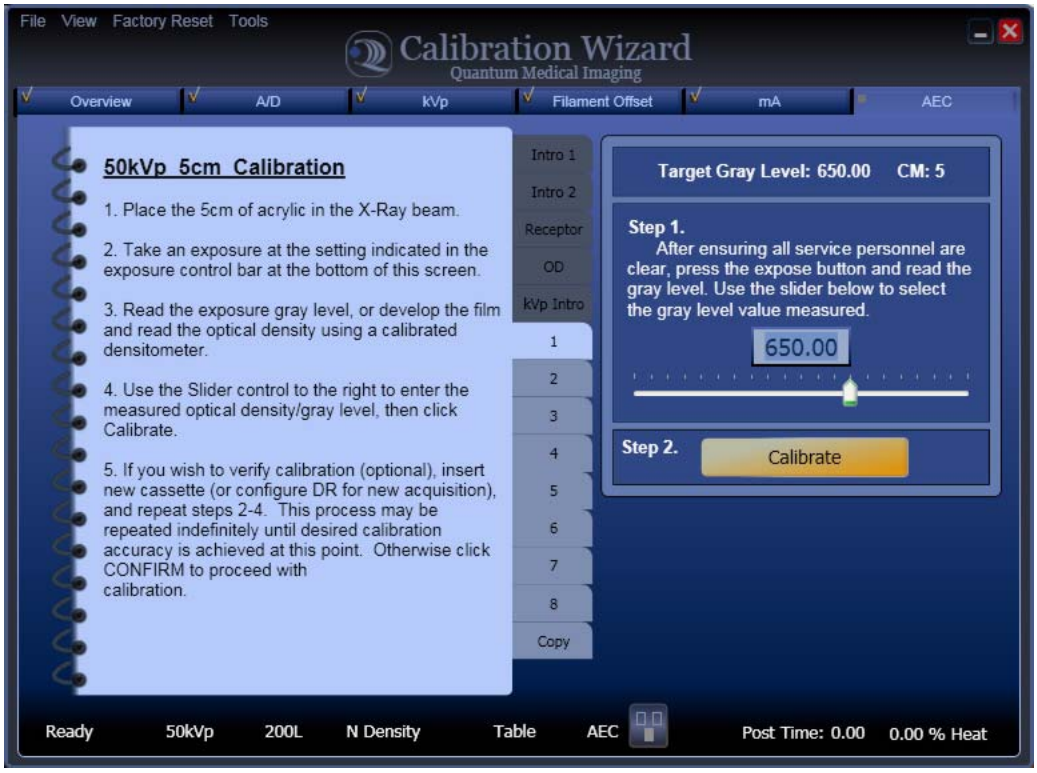

File View Factory Reset Tools
Calibration Wizard
Quantum Medical Imaging
Overview
A/D
kVp
Filament Offset
mA
AEC
50kVp 5cm Calibration
1. Place the 5cm of acrylic in the X-Ray beam.
2. Take an exposure at the setting indicated in the exposure control bar at the bottom of this screen.
3. Read the exposure gray level, or develop the film and read the optical density using a calibrated densitometer.
4. Use the Slider control to the right to enter the measured optical density/gray level, then click Calibrate.
5. If you wish to verify calibration (optional), insert new cassette (or configure DR for new acquisition), and repeat steps 2-4. This process may be repeated indefinitely until desired calibration accuracy is achieved at this point. Otherwise click CONFIRM to proceed with calibration.
Intro 1
Intro 2
Receptor
OD
kVp Intro
1
2
3
4
5
6
7
8
Copy
Target Gray Level: 650.00 CM: 5
Step 1.
After ensuring all service personnel are clear, press the expose button and read the gray level. Use the slider below to select the gray level value measured.
650.00
Step 2.
Calibrate
Ready
50kVp
200L
N Density
Table
AEC
Post Time: 0.00
0.00 % Heat

Figure D-33. Calibration Wizard - 50 kVp 5cm Calibration

3. Place indicated thickness of acrylic (5 CM for first calibration point) in the X-ray beam.
4. Take an exposure at the setting indicated in the Calibration Wizard - 50 kVp 5cm Calibration screen (i.e., 50 kVp, 200L mA, normal density).
5. On film systems, develop the film and then measure its optical density. On CR or DR systems, observe the density level displayed on the integrated system's workstation computer.
6. Enter the observed density value in the 50 kVp 5cm Calibration screen (Step 1.) by adjusting the slide control, or by selecting the data entry box and typing the value using a keyboard. The value entered should be to the hundreths decimal place. Press the **Calibrate** button.
   a. If the density value is within acceptable range of the Target Level (on CR or DR systems, refer to manufacturer's specifications), press the **Confirm** button to proceed to the next AEC kVp calibration point.
   b. If not within range, press the **Repeat** button to re-take the exposure

and re-enter the observed density value. Continue until the measured density value equals the Target Gray Level setting to within acceptable limits. When it does, press **Confirm** button.

c. The system advances to Calibration Wizard - 60kVp 10cm Calibration screen.

7. Repeat the previous steps for the 60, 80, 100, 110, 120, and, if 150 kV system, 130 and 140 kVp calibration points, placing the specified thickness of acrylic in the x-ray beam as indicated on the Calibration Wizard - AEC kVp Calibration screen for each kV calibration point, until all the observed density values are within required range.
8. This completes AEC calibration for this particular Receptor/Film Screen. Repeat AEC calibration procedures for all additional Receptor/Film Screens that will be used with the system.
9. Verify AEC calibration by taking several exposures in AEC mode and checking the resulting density value. If necessary, repeat AEC calibration procedure to further adjust AEC accuracy.

Copy Receptor Calibration Tab

Typically, the AEC calibration parameters for each of the various Receptors/ Film Screens used with the generator are quite similar. Therefore, the "Copy" function (shown below) can be used to copy calibration parameters from one Receptor/Film Screen to another. For example, after completing AEC calibration of "Wall72" Receptor/Film Screen, the Copy Receptor Calibration function can be used to copy its AEC calibration data to the "Table" receptor.

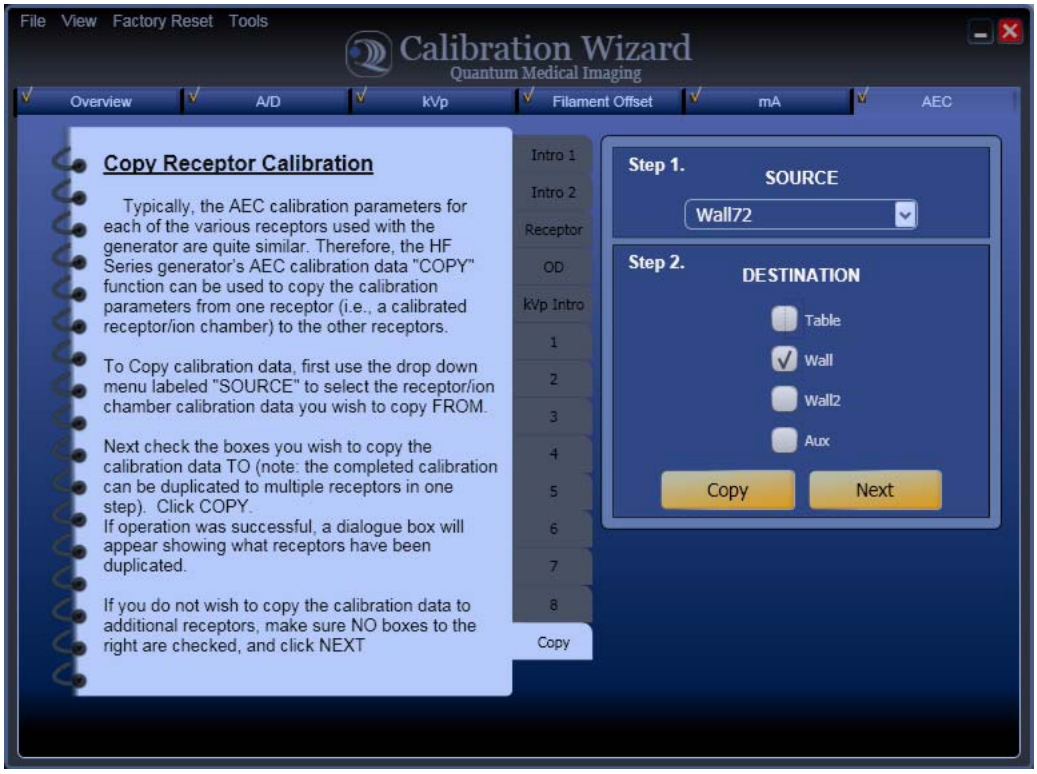

File View Factory Reset Tools
Calibration Wizard
Quantum Medical Imaging
Overview
A/D
kVp
Filament Offset
mA
AEC
Copy Receptor Calibration
Typically, the AEC calibration parameters for each of the various receptors used with the generator are quite similar. Therefore, the HF Series generator's AEC calibration data "COPY" function can be used to copy the calibration parameters from one receptor (i.e., a calibrated receptor/ion chamber) to the other receptors.
To Copy calibration data, first use the drop down menu labeled "SOURCE" to select the receptor/ion chamber calibration data you wish to copy FROM.
Next check the boxes you wish to copy the calibration data TO (note: the completed calibration can be duplicated to multiple receptors in one step). Click COPY.
If operation was successful, a dialogue box will appear showing what receptors have been duplicated.
If you do not wish to copy the calibration data to additional receptors, make sure NO boxes to the right are checked, and click NEXT
Intro 1
Intro 2
Receptor
OD
kVp Intro
1
2
3
4
5
6
7
8
Copy
Step 1.
SOURCE
Wall72
Step 2.
DESTINATION
Table
Wall
Wall2
Aux
Copy
Next

Figure D-34. Calibration Wizard - Copy Receptor Calibration

After copying the "Wall72" AEC Calibration data to "Wall", the only further AEC calibration usually required is performing Base OD Calibration to set the "Offset" value. Similarly, the "Wall" Receptor/Film Screen calibration data can be copied to the "Table", however, the table ion chamber's MASTER GAIN potentiometer must be adjusted as required. Be sure to verify the AEC images for each SID/receptor meet applicable regulatory agency requirements. If required, further optical density accuracy can be attained by performing the "AEC kVp Calibration" procedure for each copied receptor. Proceed as follows:

1. On the Calibration wizard - Copy Receptor Calibration screen (Step 1.), select a previously calibrated Receptor/Film Screen to copy calibration data from (touch or click on the down arrow at the right end of source field to display additional choices). For this example, "Wall72" is selected.
2. On the Calibration wizard - Copy Receptor Calibration screen (Step 2.), select the Destination Receptor/Film Screen(s) to copy the calibration data to.

CAUTION! Before proceeding, verify the "SOURCE" and "DESTINATION" copy selections are correct. Selecting Copy as directed in the next step will cause calibration data for the destination Receptor/Film Screen to overwrite existing calibration Receptor/ Film Screen data.

3. Press the **Copy** button.
4. A Copy Results dialogue box will appear to confirm the copy function was executed successfully. Press **Ok**.

5. The Calibration wizard - Copy Receptor Calibration screen (Step 3.) is displayed (see below). To perform another copy operation, press **Yes** button and repeat steps above. To exit the copy utility, press **No** button.

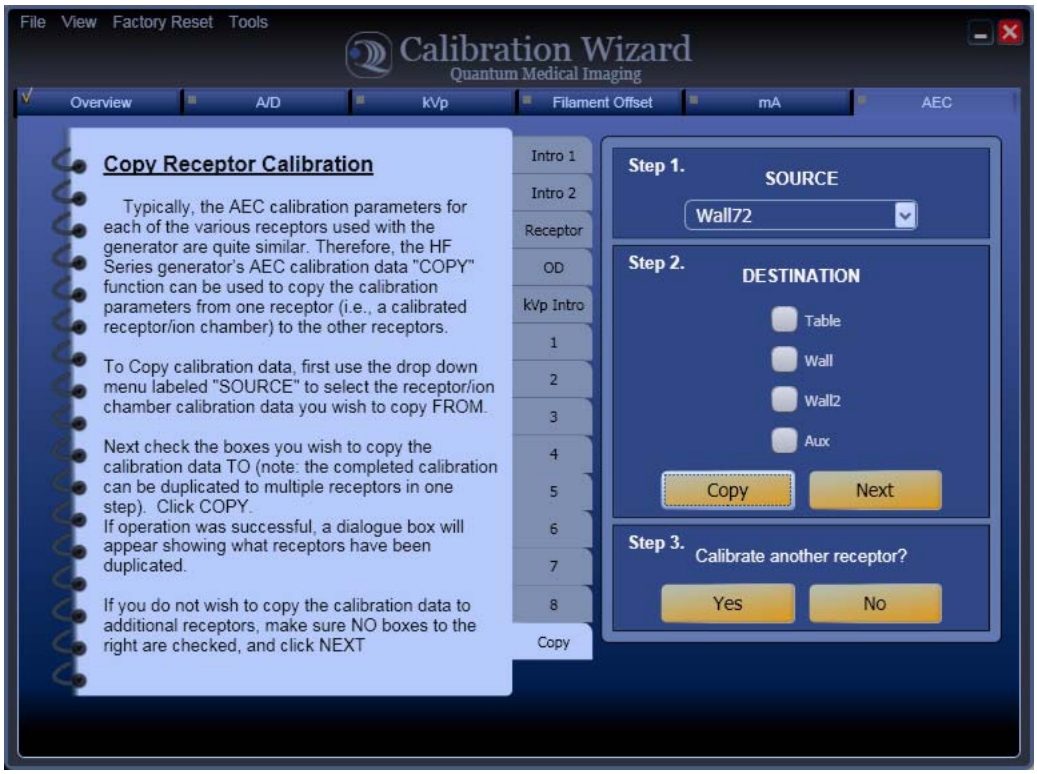

File View Factory Reset Tools
Calibration Wizard
Quantum Medical Imaging
Overview
A/D
kVp
Filament Offset
mA
AEC
Copy Receptor Calibration
Typically, the AEC calibration parameters for each of the various receptors used with the generator are quite similar. Therefore, the HF Series generator's AEC calibration data "COPY" function can be used to copy the calibration parameters from one receptor (i.e., a calibrated receptor/ion chamber) to the other receptors.
To Copy calibration data, first use the drop down menu labeled "SOURCE" to select the receptor/ion chamber calibration data you wish to copy FROM.
Next check the boxes you wish to copy the calibration data TO (note: the completed calibration can be duplicated to multiple receptors in one step). Click COPY.
If operation was successful, a dialogue box will appear showing what receptors have been duplicated.
If you do not wish to copy the calibration data to additional receptors, make sure NO boxes to the right are checked, and click NEXT
Intro 1
Intro 2
Receptor
OD
kVp Intro
1
2
3
4
5
6
7
8
Copy
Step 1.
SOURCE
Wall72
Step 2.
DESTINATION
Table
Wall
Wall2
Aux
Copy
Next
Step 3.
Calibrate another receptor?
Yes
No

Figure D-35. Calibration Wizard - Copy Receptor Calibration (Step 3)

6. The system displays the Calibration Report screen as in the example shown in Figure D-36.

Figure D-36. Calibration Wizard - Copy Receptor Calibration (Step 3)

7. The Calibration Report screen should state "All selected calibrations complete", as shown in the sample screen above. If so, press the **Exit** button to close the calibration wizard.

8. If all selected calibration procedures were not completed, the Calibration report screen will state "Incomplete" and list the procedures not performed. Select **Perform another calibration** to perform the calibrations, or select **Exit** to close the calibration wizard.

Appendix D Calibration (Using Generator Service Tools)

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